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The
GEOGRAPHICAL JOURNAL

Vol CXXVII Part 1 *March 1961*

THE ORDNANCE SURVEY AND ARCHAEOLOGY, 1791–1960

C. W. PHILLIPS

THE OBJECT of this paper is to show how the Ordnance Survey is dealing with archaeology today. In order to give a just view of present practice it is necessary to begin by showing how archaeology became a regular feature of the Survey's work between 1791 and 1947.

Although Great Britain is the only country in the world to give special attention to the showing of archaeology on its national plans no specific authority for this can be found. The Ordnance Survey Act of 1840 on which all work is based today is silent about it, and the only official notice it has had is the approval given to it in the Davidson Committee's Report of 1938 which set the stage for the Survey's work today.

It is not possible to give any clear account of why, after the publication of the first 1-inch O.S. map in 1801, a steadily increasing amount of well-observed archaeology began to appear on the original 1-inch map series. Obviously there must have been general agreement that the survey of the countryside should include the delineation of all surveyable archaeological features which could be shown at this scale, even where they were not objects of great physical bulk and importance. Here we may perhaps see the "prehistory" of the Ordnance Survey at work, for General William Roy, whose influence was paramount in promoting the idea and practice of national survey, had a career in which many would regard his achievements as a field archaeologist as scarcely inferior to his work as a geodesist and surveyor.

The frequent appearance of archaeological features on the pre-Ordnance Survey county maps of the eighteenth century reflected one of the interests of the stratum of society for which these maps were chiefly made and, with all their defects, they were in some degree a model for the more accurate productions of the Survey. The advice of the Royal Society was also important in determining the principles of the Survey in its earliest stage, and at that time it contained some of the leading archaeologists in its Fellowship. Finally the early work was done in the age of the Romantic Revival so that the intellectual climate of the time cannot have been without influence.

The hard fact remains, however, that although great progress was made in the showing of antiquities on the 1-inch maps until 1825, it was the beginning of the 6-inch survey of Ireland in that year which gave the practice great development and definition. In drawing up his instructions for this Survey Thomas Colby made elaborate provision for the investigation and survey of the field antiquities which abounded in Ireland, and success in showing them was further ensured by the work of John O'Donovan, the Survey's Irish language expert. Although first employed to

deal with names, he was insensibly drawn into the study of Irish antiquities and was in fact, if not in name, the Survey's archaeology officer for Ireland until the completion of the work in 1846.

Between 1850 and 1898 the whole of Great Britain was surveyed on the 25-inch and 6-inch scales. At an early stage in this Survey, Sir Henry James applied the principles for the survey of antiquities which had been laid down by Colby in Ireland, and a great deal of help in identifying and describing them was given by national and local archaeological societies. As a result a vast number of sites and features appeared on the plans and this was a great achievement, but the quality of the work suffered from the absence of any coordinating authority with wide archaeological knowledge at headquarters to secure a proper balance of treatment over the whole of the area surveyed. O'Donovan was to have no equivalent in England for many years, and the twentieth century had not gone far before an increasing number of complaints were made about the erroneous descriptions of antiquities and the absence of revision.

A decisive move to meet this criticism was made by Sir Charles Close when, in 1920, he received authority to appoint an Archaeology Officer whose task was to advise the Director General on all matters relating to archaeology in the Survey. The late O. G. S. Crawford was the first holder of the post and in the twenty years to 1940 he made his mark in it. He came to the Survey at a difficult time when a bout of economy in public expenditure had reduced its work to a low ebb. It was thus not possible for him to have much direct effect on revision, but the slow tempo of this period in Survey history made him relatively free to carry out two great objects, the formulation of the principles which must guide field archaeology in Britain, and a steady propaganda for the use of new techniques, among which air photography was the most striking in its results. He also began and carried well forward the production of the period maps for which the Survey is well known. Interest in historical maps had begun in 1870 when Sir Henry James produced a version of the fourteenth century "Gough" map of Great Britain, and later in 1914 a facsimile of Symonson's map of Kent was issued. Crawford's work on period maps enlarged and publicized the distributional method of archaeological study in which he was a pioneer. He began with the map of Roman Britain in 1923 which has subsequently gone to its third edition in 1956. Among maps dealing with prehistoric subjects were a series at quarter-inch scale on Britain in Neolithic times, and several illustrating the Celtic agriculture of Salisbury Plain. In the historic period a map of Britain in the Dark Ages and another on England in the seventeenth century were also published. Since 1947 a map of Monastic Britain has gone through two editions, a general interest map called Ancient Britain appeared in 1951, and several more maps are well on the way to production, including a second edition of the Dark Ages map and Britain in the Iron Age.

The production of these period maps is the best known part of Crawford's work for the Ordnance Survey. Ill luck dogged the closing part of his career. The findings of the Davidson Committee in 1938, set up to examine the affairs of the Survey as a whole, commended his work and recommended its continuance, and there were prospects of wider activity in keeping with the increased pace of the general work of the Survey. But war broke out, the Survey's Headquarters at Southampton was wrecked, archaeology was closed down for six years, and Crawford had retired before normal work was resumed. It is worth noting that the records of his branch were saved from the holocaust of 1940 by his own independent initiative.

The conditions which met those who had to rebuild the peacetime structure in 1945–6 were very different from any which Crawford had known. The staff of the

Survey had been greatly increased, new methods of revision and new scales of survey had been brought in, and there was an immediate priority for the survey of all towns at the scale of 50 inches to the mile.

The only thing which remained of the pre-war situation in archaeology were Crawford's records, which had been saved from the disaster of 1940 by his own foresight. But there were other hopeful facts. The immediate programme of the Survey was one which, by reason of its predominantly urban nature, would not require much intervention from archaeology, and a number of years must elapse before much would be undertaken in rural areas where archaeology abounds. A respite was thus granted in which some new thinking could be done, new methods evolved, and a staff recruited for this specialized work. Owing to the rapid growth of building and new users of land which had been undertaken under stress of war, and which would have to be continued in the peace, it was clear that a grave threat to antiquities existed which must be met early. Unless they could be surveyed and recorded in the coming decades they might be a dead loss. The general revision of the whole country, of which the 50-inch urban survey was the first phase, would give an opportunity to deal with this question in time.

If a State is to pay intelligent attention to its archaeology it is plain that a first requisite is accurate and complete knowledge of the topography of all monuments and sites. Any attempts to preserve or schedule monuments, or to produce detailed studies of them, ought to proceed from this. Before the end of the nineteenth century the Survey had made a large contribution to such knowledge, but even as late as 1946 circumstances had not favoured its proper organization, revision and maintenance. As a body charged with the duty of complete survey coverage of the country, and traditionally concerned with the survey of antiquities, the Ordnance Survey is the natural place for a national record of archaeological topography to be made and maintained. The reconstruction of the Archaeology Division of the Survey was therefore undertaken with this in view, and at a time when mass means of communication have caused a great upsurge of interest in archaeology. The days of the leisured and wealthy amateur have passed away, but today a thousand people are eager to learn more of the subject for every one who cared about it when the Survey was founded 170 years ago.

Reorganization appeared to require two essential elements, the first a recording body to gather information from all sources and reduce it to a good common standard of accuracy based on the country's ancient divisions, the counties. The main sources would be the whole of past and current archaeological literature, historical records, documents, early maps and plans, the results of field reconnaissance, and the use of new techniques like air photography. The second element would be a body of field investigators with a good knowledge of field archaeology and fully trained in Ordnance Survey methods to check the records made in the office against the facts in the field, to look for new sites, and to provide the Survey with accurately described and surveyed material for use in revision.

In practice, the topographical index cards produced by the researchers of the recording side would become the brief on the basis of which the field men would work. This might lead to the confirmation or the modification of the information on the cards in various ways, but the completed result, when returned to the index, should be authoritative and from it all the necessary and desirable revisions and additions to Ordnance Survey maps of all scales could be made.

There was also the question of the scope of the enquiry in time and subject. In 1940 it was still the official view that the Survey did not note any antiquities later in date than 1688, and the world at large still took the view that archaeology hardly

extended very far into the Middle Ages. In the last thirty years many things have happened to change these ideas. Our knowledge has extended both backwards and forwards in time, and from these old standards the subject has been considerably refined in detail and whole new fields of enquiry have been opened up. A single example may suffice to illustrate the last point. Until recently no one paid very much attention to the field aspect of deserted village sites. Their abandonment was generally put down to enclosures for sheep farming in the fifteenth and sixteenth centuries, but recent work has shown the causes to be far more complex and to extend over a much longer range of time. There are now known to be more than 2000 of them at a conservative estimate. Their sites are often complex and full of well-marked features whose size and strong relief have long preserved many under grass, though heavy earth-moving machinery is now beginning to make an end of their relative immunity from disturbance. It is also no longer possible to ignore the fact that the earlier stages of the Industrial Revolution are receding into the past and that modern developments are destroying all surface evidence of their topography right and left. This has now become a matter of public concern and it is interesting to note that, although the official policy of the Survey has only recently laid down that recording shall be carried on with sites of as late a date as 1800, the Archaeology Division has in fact recommended the collection of such information to its correspondents for the past ten years.

These are some of the general ideas which lie behind the present methods of work, but there was not much to give them practical effect in 1947. A staff had to be gathered and trained and the problems which would be met with in a general revision had to be examined and solved. After a gradual start an effective group was got together by 1955, and today the staff is fifty-nine strong. It has always been a difficulty that all staff has to be taken from the general body of the Survey, where none have ever been recruited with this purpose in mind. In the outcome the results have been quite good and today there are some very able people working in all parts of the Division.

Between 1950 and 1956 the different problems of recording and field-work have been explored. An initial difficulty with the first activity has had to be overcome because it is only recently that the new series of 6-inch maps with sheet lines derived from the National Grid has appeared in large quantities. It has always been necessary to maintain a complete set of 6-inch maps to act as a visual index to areas and to bring users of the records into quick and accurate relationship with the card index which has been maintained by counties in the order of the now obsolete County Series of 6-inch maps. Since the National Grid reference of every site appears on its card, and the new 6-inch maps are based on the Grid, it is not difficult to bring the arrangement of the cards into accord with the new maps, but the great number of cards makes this a long process. This is a penalty of working in a period of transition, but it is being overcome and large progress has now been made towards the total recording of the whole country. A local development of our own, called the Mini-index, has broken down the content of long runs of national and other periodicals, so that reference to their content in relation to localities is easy.

The work of the recording side has become quick and accurate in its capacity to seize on essentials and range them in good order. Here it may be mentioned that all available information is recorded even though it is of minor character and uncertain in some particulars. It is always possible that further work both in the library and in the field may remove this uncertainty, and meanwhile the incomplete material acts as a clue to further discovery. Only a proportion of what is gathered in can ever appear on any published Survey maps of the normal series, but if the full content of

the country in any particular is known it is then possible to compile accurate maps of the period type. Work on these is always in progress and makes a fully detailed record necessary.

Both in recording and in field investigation experimental work has been within the framework of the county. There is much convenience in this, for though few counties are archaeological regions in their own right, the organization of local interest in the subject has always been, and continues to be, on a county basis through the activities of many local societies which are recorded in their published proceedings. Some eight counties in England, Scotland and Wales were overhauled in this way before the onset of rural revision by the Survey as a whole made a new type of programme necessary. In the course of this work the field investigators were able to make estimates of what required to be done in different areas. In some cases the work of the Survey on the archaeological side had been quite thorough in the nineteenth century and only minor adjustments were necessary; in other cases large quantities of sites and features have been found which escaped the attention of the earlier surveyors. To some extent this variation was caused by the differing degree of personal interest which officers in charge of the original survey parties took in antiquities.

The sampling process had reached a point by 1956 at which it was possible to adjust future programmes of work to the direct needs of the Survey. In the last two years the 50-inch programme of urban survey has moved far enough towards completion to allow a beginning to be made on rural work. Priority of treatment in revision depends on density of population as determined roughly by the number of houses in an area. It is anticipated that the present general revision will be completed in the 80's of this century, and we must now look at the organization of the Ordnance Survey to achieve this purpose.

Great Britain is divided into six regions of roughly equal population, and the most homogeneous of these is the Scottish Region, which comprises all Scotland and the north of England down to Hadrian's Wall. The other five are disposed round England and Wales and vary considerably in size, while having no reference whatever to archaeological regions. In each Region there are four or five blocks of country under revision at the 25-inch scale at the same time, and in Scotland there is the additional complication that a 6-inch re-survey of the Highlands, largely by photogrammetrical methods, is now in progress. In the Archaeology Division the effective treatment of Scotland has always been a problem because of its remoteness from headquarters and the special character of much of its archaeology. In the autumn of 1958 it was decided to set up a sub-office of the Division in Edinburgh in the Scottish Regional Office to pay special attention both to 25-inch revision and to the 6-inch resurvey within the Region. This has a staff of seven under the Assistant Archaeology Officer. Elsewhere in the Regions to the south three members of the Division field staff operate in each Region. All Regional programmes are known well in advance and it is the aim of the Division both to record and also to carry out field investigation in each block before the ordinary revisers reach it. Archaeology models showing what has to be done by the revisers are supplied to the Regional headquarters. In these the field staff indicate where adjustments must be made to older defective detail survey; they also themselves survey new sites which have not been shown on the maps before and, subject to checks for position, these surveys, and the other details of the models after checking by office examination against records, are accepted for incorporation in the final documents which form the basis for the new editions drawn and published at Southampton.

In the course of their work the field staff often introduce further details into the

index cards for the area on which their work is based as well as turning up entirely new material for the record. Thus by the completion of the general revision there should be a complete record of British archaeological topography in the offices at Chessington and Edinburgh; further, this will not be static on completion in any area, but will continue to accrue for the benefit of further revisions and knowledge generally. This continuous aspect of the work is of great importance and compares favourably with that of some other institutions which are unable to continue their work in it effectively once they have completed the inventory of a county, excellent though that inventory normally is.

Set out in this way the revision process appears to be comparatively easy, but there are many difficulties to be overcome. The first, which will not arise for some time yet, comes from the fact that ancient sites of all kinds always tend to survive in recognizable form in greater numbers in remote and thinly populated areas even though in fact those areas were only marginal to the more thickly populated ones of ancient times. This survival often arises from the larger use of stone in construction, and from the fact that absence of cultivation and other disturbance today has led to a greater chance of survival where the predominantly wooden constructions in more favoured areas have disappeared long ago. We have our means of finding the latter by air photography and excavation, but they do not affect the revision problem very much. Because of this survival, the work of the field men of the Division will increase as areas of thin population are reached, in contrast to that of the Regional revisers who will be able to move much faster. This may cause difficulties in the later stages of the revision.

Another problem arises from the very basic character of thousands of minor ancient farmsteads, cattle enclosures, and the like in upland regions, and particularly in Scotland. These can be recognized readily enough, but it is another thing to date them even approximately. While in England and some of Wales all native life in Roman times was strongly influenced by Roman civilization this was much less the case in Scotland, where we have a Roman Iron Age which continues on from prehistoric times and merges insensibly into the Middle Ages and early modern times.

It is the difficulty of dealing with sites like these which has led to a change in the use of types to indicate antiquities and their relative age. Dr. Crawford introduced a system by which two distinct forms of Gothic type were used to indicate sites of pre- and post-Roman age, while Roman sites were given another type altogether. What is to be done when it becomes clear that large numbers of sites like the ancient peasant sites of southern Scotland and elsewhere in the Highland Zone cannot be put firmly into any one of these categories? In due course a long process of excavation may single out distinctive types which can be dated with fair accuracy, but that day is not yet. As a result it has been necessary to adopt one Gothic type for all sites which are not Roman, whether older or younger, and one quite different for sites of Roman age.

Air photography, which has revealed so many unsuspected sites since 1920, can also cause embarrassment by the sheer lavishness of its gifts and their complexity in some of the more favoured parts of the country. Gravel spreads in river valleys have always attracted settlers from the earliest times. Many air photographs have been taken of the Middle and Upper Thames area above Wallingford, and of the Welland gravels east of Stamford. In both cases a veritable palimpsest of successive occupations shows up in the form of ancient field ditches, barrow circles, farm places, and miscellaneous compounds, the period covered by which is known to range from before 2000 B.C. to Roman times and later. All of this inextricable tangle can be accurately plotted in plan form on the map, even where the internal stratigraphical

relationships are not known, but it is obviously undesirable to show it on a map which may otherwise contain comparatively little modern detail. It is only where something of unusual importance turns up like the "Henge" monument at Dorchester, Oxon., that it is desirable to show it on the large-scale plans. This question of acceptance and rejection raises some nice problems and it is often difficult to make a correct decision. Attempts to make rigid rules tend to fail, and many discussions are liable to occur in the Office before a decision is made. In any case, these complex sites are carefully plotted and kept in the records of the Division. The conditions mentioned above are known to apply also to the valleys of the Trent, the Warwickshire Avon, and the Severn in varying degrees and future work will certainly lengthen this list.

A comparable situation exists in the Fenland, where air photographs reveal an immense pattern of settlement, mainly agricultural, which belongs to Roman times. Certain of its most important features, like the Roman Fen Causeway and some of the major nucleations of settlement, will be shown on the plans, but the rest is plotted and put in the records.

Ancient field systems and deserted village sites also cause some trouble. Our knowledge of ancient field systems is fairly recent, and although many of them are only to be recognized on air photographs in the form of colour changes in growing crops, or on bare soil, there are large areas of upland in the Wessex area and in Sussex, where the boundaries and internal details of these systems are obvious on the ground, often through the formation of lynchets on the limits of the plots. Here the first stage is to lay down these complexes on to the plans from air photographs and then to correct and adjust their survey details in the field.

There is also a similar approach to the deserted villages. Some, but not many, have been ploughed right out and only appear as ghosts on air photographs; others are very apparent on the ground in a fairly high relief created by the old house places and crofts with hollowed lanes running among them. In the past the Survey often contented itself by supplying the water features, such as surviving mill dams and fish ponds with one or two of the more obvious mounds, but the complete supply of the plan is a more laborious business today.

Many of the antiquities which will be shown for the first time on the plans in the coming years lie out on featureless moors. Here the enemies of the surveyor are the absence of good points of survey reference and the frequency of mist and rain which make observation difficult. Where recent air photographs exist it has been found practicable to use natural points of reference in the form of rock formations and distinctive patches of vegetation to get these sites into their proper places.

Much more might be written about our problems and the various pitfalls which lie about our feet, but the limits of this paper only permit reference to the most obvious features of the work of the Archaeology Division. It will be seen that we have travelled a long way from the days of Roy, Colby and James, and that although our work is strongly based on what Crawford has taught us, perhaps the greatest progress will have been made after 1947. Today's work is the logical result of what was laid down by those pioneers and commands larger resources than they ever enjoyed for this side of the Survey's work. Given peaceful times we should have a complete record of the country's archaeological topography in being and subject to continuous revision well before the end of this century, and also a revised large-scale map coverage of the whole of the country carrying an accurate presentation of all the archaeology which can properly appear upon it.

DISCUSSION

Afternoon Meeting, 25 April 1960

Before the paper the CHAIRMAN (General Sir JAMES MARSHALL-CORNWALL) said: Exactly fifty years ago, when I was a subaltern in the Royal Field Artillery, my battery was sent to do its annual gun practice at a camp newly established in the Cheviot Hills, in the north of Northumberland on the Scottish Border. The name of the camp was officially known as "Ad Fines", which purported to be the Roman name of a camp situated at the north end of the range. Now, as a matter of fact, there is no documentary or epigraphic evidence whatsoever for any Roman station in this country with the name of "Ad Fines." That name, which was then the only place-name on the artillery range that I am talking about, was a complete fiction, invented by an ingenious-minded young man in the eighteenth century, called Charles Bertram, who persuaded the Society of Antiquaries of London, including the great Stukeley, the leading archaeologist at the time, that he had discovered in Copenhagen a medieval English manuscript giving an itinerary containing forty-eight hitherto unknown Roman place-names in Britain; so I think we can hardly blame the Ordnance Survey for having inserted these on the map; but when I went to that camp in 1910 we were using the 1-inch Ordnance Survey map, edition of 1907, and "Ad Fines" was still shown then. In the same year, 1910, a young geographer named O. G. S. Crawford was appointed junior demonstrator at the School of Geography at Oxford University. Crawford was not only a good geographer, he was a very enthusiastic and able archaeologist; archaeology was his hobby in life. When he was serving as a maps officer in France during the First World War he had come across Colonel Sir Charles Close, who was later Director-General of the Ordnance Survey. In 1920 Sir Charles Close, who was later President of this Society, appointed O. G. S. Crawford as the first Archaeology Officer to the Ordnance Survey. That was a very great step forward, both for the Ordnance Survey and for archaeology. Crawford did great things. The first thing he did was to expunge from the sheets of the Ordnance Survey all the forty-eight fictitious names invented by Charles Bertram. Four years after his appointment appeared the first edition of the Ordnance Survey 'Map of Roman Britain'; it was a tremendous success and was followed four years later in 1928 by a second edition. After the Second World War Crawford retired (in 1946) and was succeeded by Mr. C. W. Phillips as the Archaeology Officer to the Ordnance Survey. As a tribute to him I need only mention the third (1956) edition of the O.S. 'Map of Roman Britain' which is a masterpiece of archaeological cartography.

Mr. C. W. Phillips then read his paper

The CHAIRMAN: I am glad to see in the audience the present Director General of the Ordnance Survey, and I wonder if General Carey would like to come up and say a few words.

Major-General DE VIC CAREY: I am extremely glad that at a time when we have the resources to make good the deficiencies of the national survey, deficiencies directly due to limitations put on to the department between the wars, we can at the same time do something about putting our archaeological house in order—and it needed putting in order. I know before the War we had Mr. Crawford's most valuable advice; we had the benefit of his laying the foundations that we have used since but, owing to our lack of resources, very little went on to our national plans, and I suggest our first duty is to put the archaeological information on to our national plans. That we are doing, and it is now quite clear that within the foreseeable future, our plans will be up to date in the matter of archaeological information and our records will be complete. And, as Mr. Phillips has said, we shall have a record of the geography of our archaeology which is quite unique, and which has no equal anywhere in the world. I think it is largely now due to the very capable guidance that our archaeological division receives from Mr. Phillips.

Mr. R. A. SKELTON (Superintendent of Maps, British Museum): Mr. Phillips's talk

has given a most impressive testimony of, in the first place, the services that the topographical national survey has done for archaeology, and secondly of the national genius for doing the right thing in a rather unexpected way. The topographical surveys are supposed only to exhibit the visible topography on the map, but it is quite obvious that the archaeologist's material is not visible to the unaided human eye, and it has to be obtained partly by excavation, partly by unusual techniques like air photography, or by the magnetometer which Mr. Phillips mentioned. A lot of this material is not visible, but it has to be recorded; and it seems to me an exceptionally happy compromise, that the national survey has taken this task of recording under its wing so that, in fact, what is visible can be put on to the maps. This contains the seed of more growth still: as this record proceeds it is a continuous record, unlike other archaeological records, so the maps can be kept up to date. Archaeology owes a tremendous debt to military surveyors. We can think of various examples such as the planning of the excavations of the Old City of Jerusalem by Sir Charles Wilson, General Roy's work on Roman antiquities, and possibly the happiest gift of all was that of Sir Charles Close, when he appointed O. G. S. Crawford. Crawford was a man of immense fertility of mind and ingenuity of method, and I still remember the impact that his book *Man and his past* made on me when I read it as an undergraduate. Although he had a particular facility for personal collaboration in a very happy way, he was something of a one-man-band, and I cannot help feeling that he was much happier with his staff of six, than he would have been with a staff of fifty-nine. At any rate, he got extraordinarily good results. Mr. Phillips has shown that he is capable of controlling and putting to very fruitful use this very much larger staff he has got, and we wish him all good luck in the future. I would like to ask one question: Mr. Phillips is obviously building up an extraordinarily valuable mass of records and I do hope that they are all being put on microfilm?

Mr. PHILLIPS: Frankly, there are not any microfilms at the present moment, but the matter has been definitely under consideration. This is a matter that, of course, constantly bothers my mind, but the task is a big one; our records are of rather a major character.

Professor L. DUDLEY STAMP: This is rather out of my field, but I have been struck with one remark, namely, that far more information has been collected than is possible to put on the maps. Now, we have the Director General with us, and so, I wonder, has any thought been given to the possible issue, in those areas where it is appropriate, of archaeological editions of either the 6-inch or 25-inch map, showing these details? One feels that there are these wonderful photographs and wonderful information; admittedly the estate-owner who wants just the record of his estate might be a little embarrassed, even a little annoyed, if he had this mass of archaeological information being put on, but then there are many who would be extremely interested.

Major-General DE VIC CAREY: I think the position is, in fact, that many of the county sheets are now fifty years out of date, and until we correct that situation I don't think we can spare resources to do what Professor Dudley Stamp has suggested.

MEDICAL GEOGRAPHY IN INDIA AND PAKISTAN

A. T. A. LEARMONTH

I AM HONOURED by the invitation to address the Society, which is doing so much to foster the study of medical geography, and under the chairmanship of Professor Dudley Stamp who has long been interested in this field. I have attended two lectures in this hall by Dr. Leslie Banks, Professor of Human Ecology in the University of Cambridge, during which he depicted on a broad canvas the differing disease patterns in the developed, as compared with the under-developed or (as we hope) the developing world. My task today is to approach from the geographer's point of view some aspects of medical geography in the Indian sub-continent—a study, then, within the under-developed part of the world, in which data are sometimes lacking or inaccurate. We are sure, however, that death-rates and birth-rates are still high as compared with those in most parts of the developed world, but that death-control is tending to occur markedly earlier than birth-control. Within the sub-continent of India, using only some relatively accessible and not very accurate data, I shall try to establish whether or not this problem occurs in regionally differentiated patterns of spatial distribution and of trend over time.

The first part of this talk consists of a number of colour photographs, illustrating that there are differing patterns of disease-association in different types of human settlement and in differing environments within even a part of the sub-continent, Mysore State, which I know reasonably well.

Dr. Learmonth showed a number of colour photographs, to illustrate points elaborated below; it has only been possible to reproduce in the Journal *the four black and white photographs between pages* 20 *and* 21.

With the aid of these photographs we have this afternoon visited several Mysore villages and one urban slum, with widely varying health conditions. In the coastal region of Mysore, in which a settlement pattern of linear dispersion is typical, we have seen the relatively good health and nutrition in a fishing and in a rice-growing village. The fisher-folk are subject to some mosquito-borne filariasis; and seasonally there is stress during the stormy south-west monsoon when fishing is impossible. The rice cultivators live nearer to breeding-places of *Anopheles fluviatilis* and were subject to malaria until recent years. But both communities are relatively free from widespread outbreaks of intestinal disease, since each house has its own well. This is true also of the Malnad region—the wet, forested hill country around the Ghats Edge—but the alignment of the houses within the edge of the woodland does make for a perennial attendant population of house-flies and constant sapping by dysentery (plate 1). Until recently this has been an area of severe hyperendemic malaria carried by *A. fluviatilis*, breeding in forest streams. And respiratory diseases are heavy in places, possibly because of stress in the long, wet season. In the black cotton soil country, a compact village of flat-topped and mud-walled houses has been subject to severe epidemics of plague—now in retreat—and of influenza, particularly during the pandemic of 1919, also to famine or near-famine. The embanked and excavated tanks for drinking-water and the masonry step-walls are both guilty of continuing the endemic transmission of guinea-worm. Here and in the next village there is high mortality in the cool season from pneumonia associated with universal diseases like measles and bronchitis (plate 2). In the rolling granitic country farther south

near Bangalore, tank irrigation has given some stability in health and demographic conditions, at least since the great famine of 1878. In the fairly compact brick-and-tile village there is a good deal of intestinal diseases and patchy, but locally severe, malaria, only now in retreat before the DDT campaigns. The most vulnerable group are the Harijan communities—the former outcastes—in their separate mud-and-thatch hamlet (plate 3). An urban slum of the Harijan people, immigrant from a drought-stricken Tamil-speaking area of Madras, has very high rates of infant mortality, associated with high incidence of small-pox and the universal diseases; the people are an under-privileged minority amidst the relatively good health conditions of Bangalore, the State capital (plate 4).

To what extent are these illustrations representative of differing regional associations of disease-patterns with the physical and human environments? Every village is unique, just as are individual men and women, yet no one who has travelled widely over the sub-continent, or even flown over it, can fail to notice repetitive patterns in land use, settlement pattern and in the human geography generally; I believe that such repetitive patterns certainly exist in the regional distribution and regional association of disease. Is it then possible to be quantitative about delimiting and characterizing such disease-regions—remembering always that, even more than most, these regions must be constantly changing?

It would be technically feasible, though very expensive, to design and execute sample surveys in a region, or even in a whole country or sub-continent, which would reveal a great deal of the present health picture and the recent medical history of the community, by means of clinical, pathological and serological examinations and tests. And the sample design could certainly be oriented so as to yield data suitable for mapping and subsequent geographical analysis in problems which seemed likely to have significant regional patterns. This would be a complex and expensive but quite possibly a worthwhile inter-disciplinary operation. Meantime, something much more modest can be done as a probing attack, using existing health statistics. Granting that the records are inaccurate, something can nevertheless be learned, provided that one is careful not to attach too much significance to individual figures or small patches on the map, but rather to consider broad regional differences and trends.

In examining a series of maps on Mysore State for twenty recent years, generally 1936–55, and an earlier series for the former British India for the inter-war period 1921–40, I shall refer for brevity's sake only to some outstanding features of each map, and shall omit with regret references to the many items of the medical and geographical literature of the sub-continent, often of classic quality, which come to my mind as I look at each map. I shall begin the discussion of the maps with a short series on malaria in Mysore State as it was before the reorganization of the Indian States in 1956. This may be relevant, since it is largely the area just visited with the aid of photographs. After this, however, the newer material on Mysore will be woven in with the earlier material for the former British India. These maps generally present together differences in average mortality and also in variability in mortality from year to year; (see Learmonth 1954; Learmonth and Pal, 1959). Thus high and highly variable mortality represents severely epidemic conditions, high mortality with low variability, severely endemic conditions. Inset graphs and tables give a complementary view of the numerical relationships between these two variables.

Figure 1, the map of malaria mortality in Mysore, shows the expected concentration of high values in the wet Malnad tract in the west; the high variability shown is largely due to a dramatic decrease in the malaria death-rate after the DDT campaign had taken effect in the last few years of the period. On the plateau, which in the old

State is mainly tank-irrigation country, malaria death-rates were predominantly low, but with several patches of high mortality, related to the numerous breeding places of *Anopheles culicifacies*, a still-water mosquito. The area of high mortality in the east may be due to the peculiar form of irrigation known as spring-channel irrigation. The general patchiness of incidence may be confirmed by maps of spleen rates at different dates—1928, 1949, 1952 and 1955 (Fig. 2).

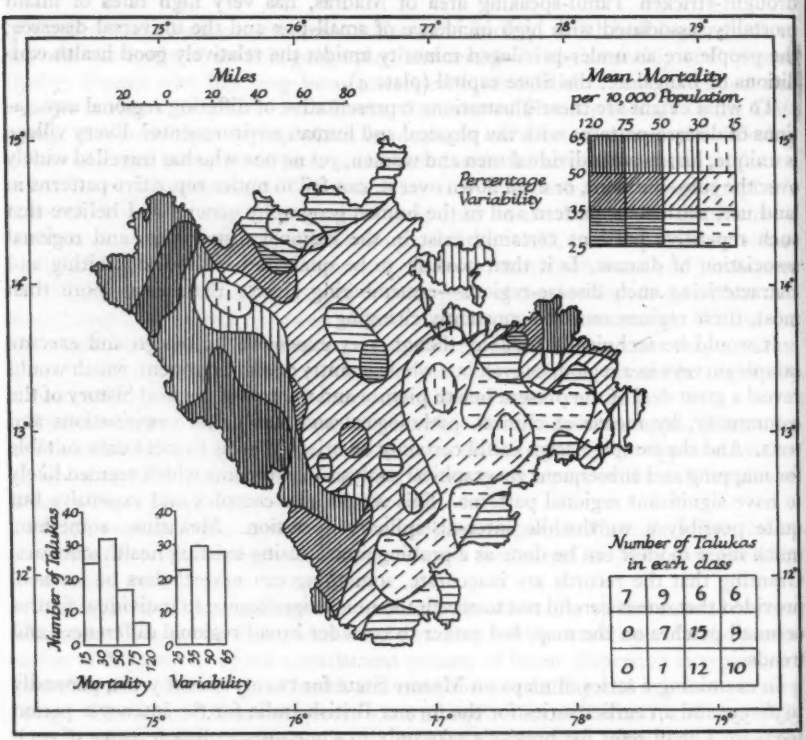

Fig. 1. Malaria mortality, Old Mysore. Note the high and variable death-rates in the wet, forested hill country of the west; the high variability is largely due to great decreases in death-rates since the malaria control campaigns after the end of the Second World War. The drier east has much lower rates on the whole, except for some irrigated areas, but in places malaria death-rates are rather steady

Turning to the series of maps for the former British India, these are drawn on similar and uniform conventions. These maps are not reproduced here, except for Figure 4 as an example, since they have already been published (Learmonth 1952; 1958). The map of birth-rates shows higher rates by denser shadings, and variability from year to year by direction of shadings; the cynic might say that this enables one to distinguish between areas of severe epidemics of births from those having (say) low endemic conditions. Both these conditions diverge from the steady high rate of increase which is the norm in most Indian communities enjoying good health, at least during her present stage of demographic development. In fact, the highly variable birth-rates, as in much of Middle India, are closely related to epidemic

diseases, while the low births with low variability, as in much of West Bengal, are related to endemic disease, especially to malaria, during the period of study. High birth-rates with low variability, as in parts of the Punjab, represent relatively healthy areas. Of course, the material is unreliable, but if errors in recording are the only cause of these areal differences, then inaccuracy runs in regional patterns. The important thing is to select only important regional groupings, and then see whether there is any consistency of pattern as between the several maps in the series. Taken map by map, and certainly District by District, the evidence certainly is unreliable, but if regional patterns in several maps hang together, then we may learn a little. Let us look briefly at two maps very closely related to that of birth-rates. The pattern of death-rates is very similar, because so many of the deaths are in young children, while the infant mortality rates, mapped separately for examination, again reveal broadly similar trends (Learmonth, 1958).

Similar mapping has been carried out for the Mysore data for the more recent period and using smaller administrative units. Again, these maps are not reproduced here except for Figures 1 to 3 as examples, since the series will shortly be published (Learmonth and Bhat, 1960). In one map, graphs for births and deaths over the twenty years have been drawn and assembled into regional groupings of similar graphs by inspection as an interim measure. There is a sudden and marked increase in births and decrease in deaths when the DDT campaigns come to malarious areas, contrasting with the more gradual decline for both birth-rate and death-rate in some eastern areas of greater urbanization and industrial and commercial influence. Again, in Figure 3, a map of over-all population change and variability in rate of change for the new (post-1956) State of Mysore, there is population decline in areas only recently freed from malaria, contrasted with high and steady increase in the southern part of the coastal plain, with high but variable increase in the famine and epidemic area of the black cotton soil tract and again with steady recovery from the 1878 famine farther south. A map of infant mortality is particularly instructive. The high and variable infant mortality of the west of the old State is probably more accurately recorded than are rates farther east at present, because they are based on health centres developed first in the most malarious areas. Nevertheless it appears that the region of greatest all-round development round Bangalore and Mysore City has markedly favourable rates; yet, there are certainly unfavourable conditions and probably also under-recording, for instance in the urban slum area shown in plate 4. Areas with high rates in the south-east are in relatively isolated tracts.

Let us examine two further All-India maps based on particularly unsatisfactory data—"fevers" and respiratory diseases. "Fevers" is always written in inverted commas in the literature because it is notoriously what one health report called a "catch-all repository"—almost as much as "all other causes"! Nevertheless, let us find out how far this pattern is related to the classic map of malaria first drawn by Christophers and Sinton in 1926. A later version of this coloured map by the Malaria Survey of India, immediately antedating the malaria control campaign, is reproduced in black and white in Learmonth (1958). Careful comparison shows that there is a sort of top-heavy appearance about the "fevers" map as compared with the malaria map—in more academic terms, a concentration of high rates in the north of the map. Keeping this distribution pattern in mind, let us turn to the map for respiratory diseases. Here the data certainly include deaths from tuberculosis, pneumonia and locally pneumonic plague—while some of the deaths from these causes are surely recorded under other headings including "fevers." These maps, then, are by no means reliable tools of analysis, but with caution we may learn a little. The general areal pattern of deaths from "fevers" resembles that of respiratory

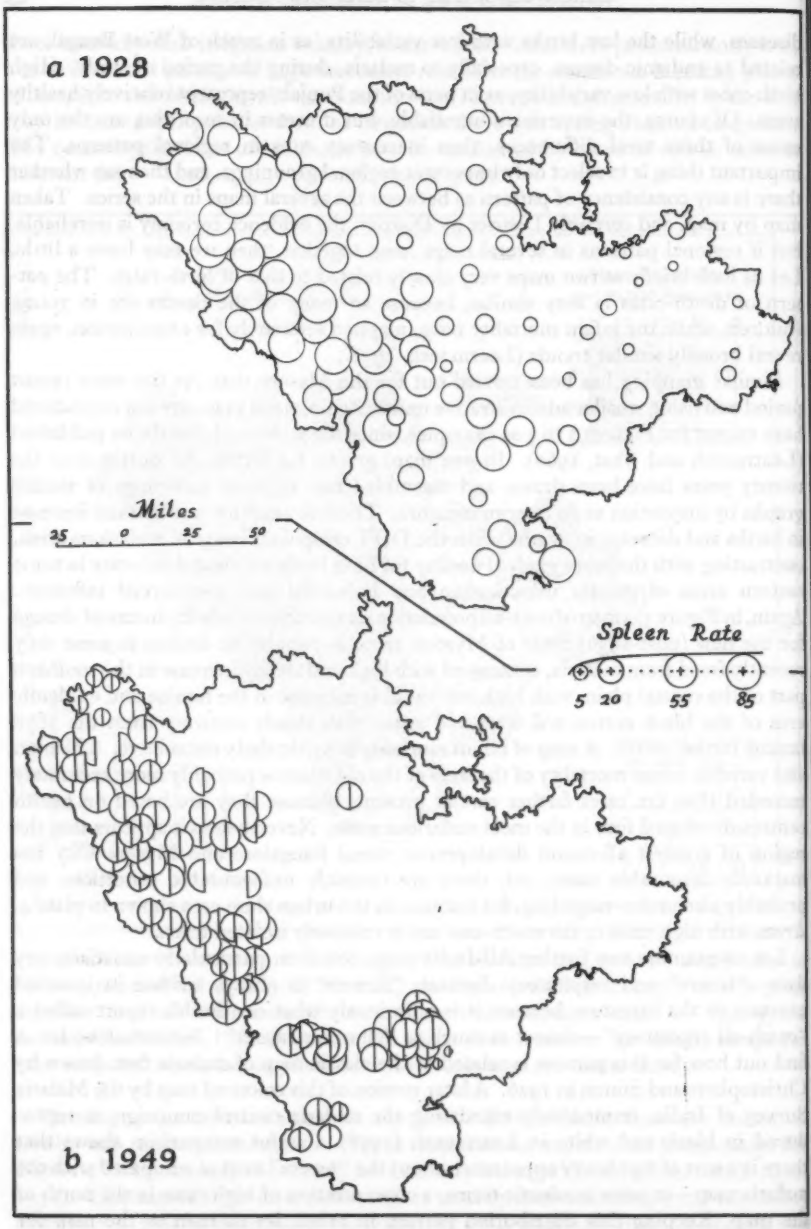

Fig. 2. Spleen rates, Old Mysore: (a) The much higher spleen rates of western Mysore, as compared with the drier east where, however, there are patches of high rates related to local irrigation; (b) The high spleen rates in the west and in the Visvesveraya canal tract near Mysore city, just before the malaria control campaign began to take effect

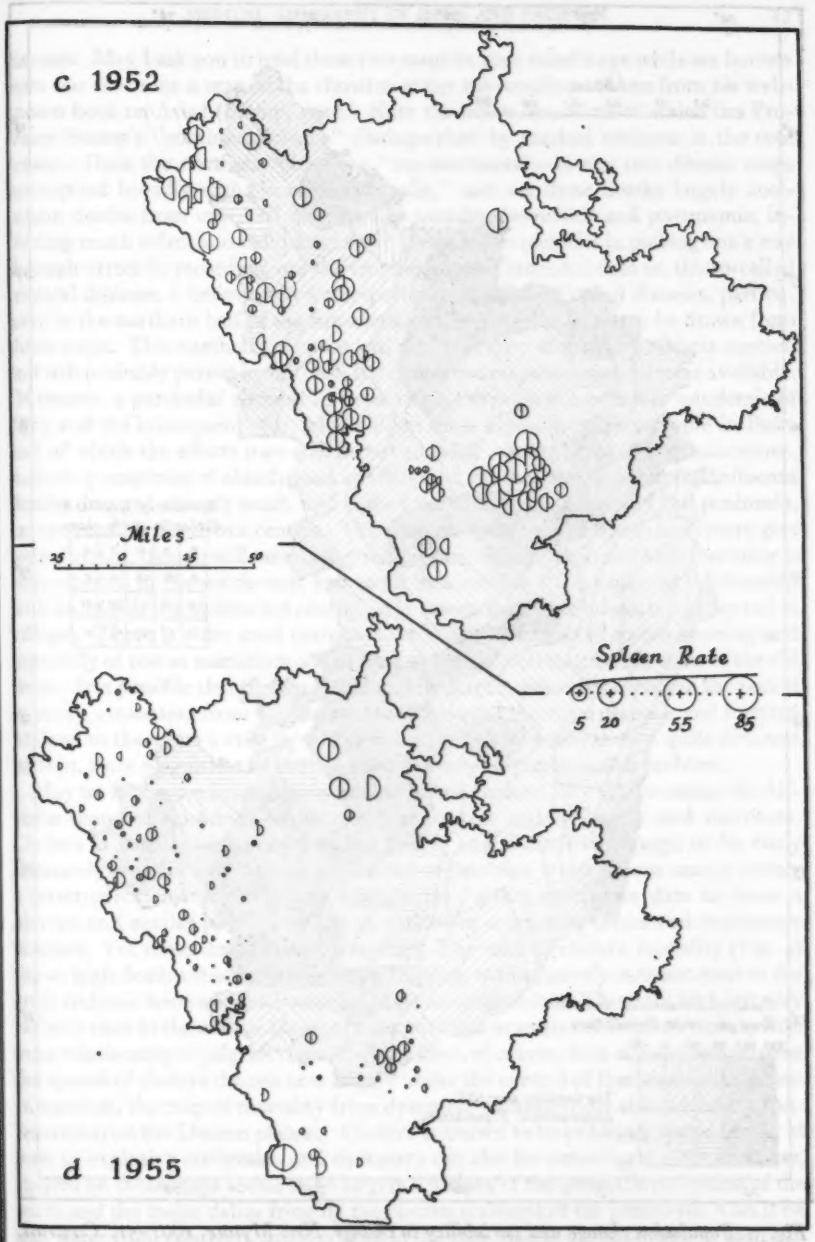

Fig. 2. Spleen rates, Old Mysore: (c) The dramatic effects of the campaign in the west, with high rates persisting in the canal tract and in malarious parts of the tank country, probably given priority in spraying; (d) Further marked reduction in the west and in the canal tract. As the area of control widens in the tank country, scattered incidence of high rates is revealed, though immediately dealt with

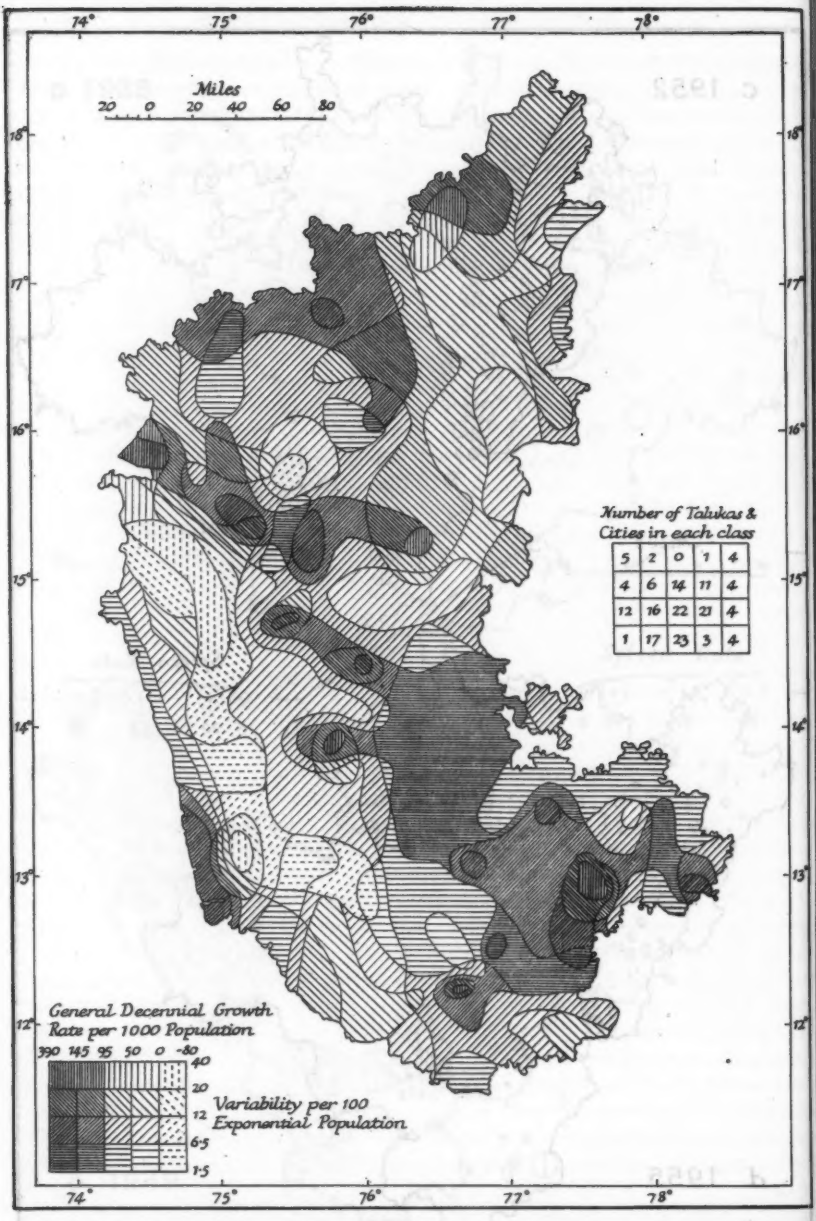

Fig. 3. Population change and variability in change, New Mysore, 1901–51. Contrast, for instance, the population stagnation or decline of much of the wet, forested hill country of western Mysore, very malarious until recently, with the steady, high increase of recovery from the famine of 1878 and active economic development in much of the tank country, or the high but variable increase in the famine and epidemic tract of the black cotton soils

diseases. May I ask you to hold these two maps in your mind's eye while we borrow from our chairman a map of the climates of the sub-continent taken from his well-known book on Asia? (Stamp, 1957.) Note the heavy line north of which lies Professor Stamp's "continental India" distinguished by marked coolness in the cool season. Does the northerly bias—the "top-heaviness"—in the two disease maps correspond broadly with "continental India," and are these deaths largely cool-season deaths from universal diseases like measles, bronchitis and pneumonia, including much infant and child mortality? Despite complexities in picking one's way through errors in recording and the emphasis in the recorded data on the so-called tropical diseases, I believe that the importance of these universal diseases, particularly in the northern half of the sub-continent, is the great lesson to be drawn from these maps. This northerly element will not be greatly affected by malaria control, and will probably persist in any post-Independence maps that may become available. Of course, a particular element in these maps has been the influenza pandemic of 1919 and the subsequent year, which killed some eighteen million people in India and of which the effects may still persist to some extent; from several indications, including enquiries of elderly men in villages, I am inclined to think that influenza deaths dropped sharply south and east of the Deccan lava tracts of the peninsula, except possibly for urban centres. The maps of respiratory diseases in Mysore give some further, though still tantalizing, indications. On this evidence high mortality is concentrated in the south-west and south-east corners. The expected relationship with industrial towns does not emerge; it is known that tuberculosis is widespread in villages. There is some areal correspondence with the areas of cotton-growing and especially of cotton marketing on the west of the two cotton-growing areas of the old State. It is possible that there was pneumonic plague, especially earlier in the period of study, emanating from the market towns between the open plateaus and forested Malnad to the west; a map for a later period might therefore show a quite different pattern, since plague has all but vanished as a serious public health problem.

May we follow our comparative method a little farther? We shall examine the All-India maps of intestinal diseases, i.e. of cholera and dysentery and diarrhoea. Cholera is usually well-known to the people and distinctive enough to be fairly accurately identified by laymen, and under-registration is not serious except during a catastrophic epidemic. Yet one might expect rather inaccurate data to cause a blurred and similar picture—rather as noticed in comparing fevers and respiratory diseases. Yet some sharp contrasts emerge. The map of cholera mortality (Fig. 4) shows high death-rates, including some Districts with relatively constant rates in the great endemic homes of the disease in most east coast deltas. There are high but very variable rates in the middle Ganges plains, and also in scattered Districts mainly with some relationship to pilgrim centres, which have, of course, been a major influence on the spread of cholera though now largely under the control of the health authorities. In contrast, the map of mortality from dysentery and diarrhoea shows a heavy concentration on the Deccan plateau. Cholera is known to be primarily water-borne, at least in explosive outbreaks, and dysentery can also be water-borne. Nevertheless, cholera on these maps seems to be largely a disease of the great alluvial plains of the north and the major deltas fringing the eastern seaboard of the peninsula. Can it be that water from relatively shallow wells in the thin mantle of rock-waste in basins in the series of great rock-platforms of the Deccan is subject to more constant pollution, related to lesser filtration, compared with wells in the major alluvial plains? And on the other hand that the more organic-rich waters of the great flood-plains and deltas specifically favour the cholera vibrio? It is the more interesting in view of these contrasts to turn to more detailed mapping for part of the peninsula, namely old Mysore

State (Learmonth and Pal, 1959). There are high values in the two main river basins, the Tungabhadra and the Cauvery, but with very variable rates. It is possible that pilgrim centres of local significance may be involved. The nearest approach to a local endemic focus, on this evidence, is in the thirty-year-old canal tract near Mysore City, with medium but relatively stable death-rates; it is not of course at all on the

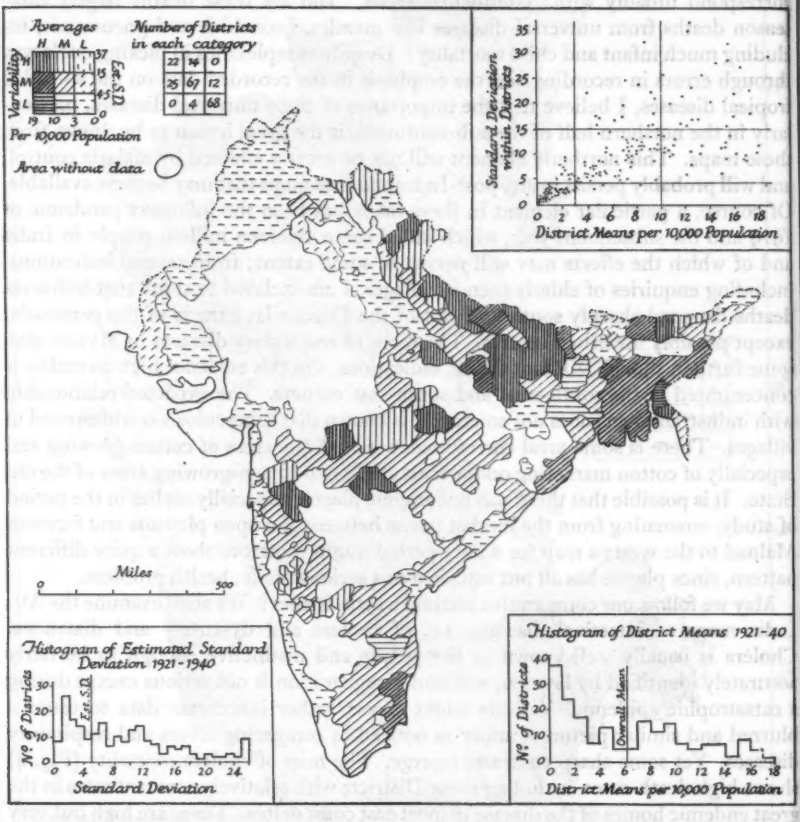

Fig. 4. Cholera mortality, British India, 1921–40. There is a high mortality in the great endemic homes in the east coast deltas (except Godavari–Krishna), mainly with medium variability. This compares with high mortality and high variability—more epidemic conditions—in the Middle Ganges Plain and adjacent areas along the hill-foot. The areas of high mortality are linked by areas of medium mortality with medium to high variability, mainly within areas of sudden falling off to areas of low mortality and low variability; hence, the use of specially large areas as Districts conceals small local epidemics

scale of the great endemic homes already referred to, in the east coast deltas. In Mysore, typhoid shows a fairly similar pattern, as might be expected from a disease also water-borne. But commonly both dysentery and diarrhoea again show a somewhat different pattern, with the highest rates in the wet Malnad, and an extension into the central granite ridge country, again somewhat wetter than adjacent plateau

areas: the drier east, except for one or two heavily irrigated areas, has relatively low rates.

The two remaining All-India maps of mortality also concern epidemic diseases—plague and smallpox. Plague again is markedly concentrated in the northern half of the sub-continent and plague, bubonic and pneumonic, certainly contribute to the pattern already noted in the maps of "fevers" and respiratory diseases. The three foci along the northern hillfoot are part of the ring of endemic centres round the enzootic core area of Central Asia, where rodent plague simmers quietly among the marmots (Pollitzer, 1954). At least the peninsular area owes the present phase of plague, now in retreat, to the introduction of the disease by ship from China to Bombay in 1896. Rat plague and human plague spread from Bombay along the trade routes and especially to market centres in the cotton-growing areas. Its sharp restriction to the drier parts of India seems to be due primarily to the prevalence in humid India of a rat-flea which is a less efficient vector of plague, although dispersed settlement may restrict and nucleated settlement favour transmission. Smallpox shows no clear relationship with broad patterns in the physical environment but rather, perhaps, to tracts including heavily urbanized areas. Yet in Mysore, for the later period, the detailed mapping shows urban centres in a distinctly favourable light, presumably owing to better health centres and specifically to more widespread vaccination and despite high rates among underprivileged groups there. For the rest there is a marked cartographic correlation with the nucleated settlement type, while the highest and most variable rates are in peripheral and isolated areas.

Can all these strands be pulled together in a synthesis? An attempt to do this by objective methods fails, because of the great number of permutations possible, or even those actually encountered among so many variables. But a subjectively drawn map has been published (Learmonth, 1958). We may contrast, for instance, Punjab, with epidemic malaria, plague and universal diseases including influenza and pneumonia, especially during the sharply cool season and, on the other hand, (say) the Cauvery delta with endemic malaria, endemic cholera—and one may add distinctly poorer nutrition—but with no plague or influenza to speak of, on the evidence reviewed. A first map of calories and protein in the diet of lower-income families has been prepared from surveys unfortunately far from simultaneous but during almost the same period as the maps of the former British India. Punjab families enjoy larger portions of both calories and proteins than do families in south-eastern India; we must add, however, that the cool weather in Punjab demands more calories, and that many of the surveys in South India were taken during a series of bad harvests just after Independence. Taking all our evidence together, we may gain a first broad picture of regional differences in health and disease in the Indian sub-continent towards the end of the British period. As in the map of population trends used earlier for Mysore, one possible basis of synthesis is a map of population change and variability in change (Geddes and Learmonth, 1953). One may compare, for instance, the low increase and low variability in West Bengal, then subject to severe endemic malaria, with the high but variable increase of the cotton-growing country behind Bombay, vigorous in so many ways but subject to famine and epidemic.

All the work in medical geography with which I have personally been associated has been on a broad regional scale, with the objective of looking at the whole picture of health and disease so far as easily accessible data permitted. The intention has been to contribute to human geography, or in Mysore to a general regional survey for planning purposes. The object, if you like, was to complement the ordinary map of population distribution with some knowledge of the quality of life lived in differing regions, from the particular aspect of health and disease. Any interest aroused

among medical workers is of course gratifying, and perhaps some of the methods may be useful in other contexts or other countries. A geographical contribution leading to new medical knowledge has not been the aim. But the work may possibly encourage the idea that a geographical contribution to a team might be justified in relation to a study in depth of a problem involving an areally differentiated disease in an underdeveloped tropical country.

A study in depth is one possibility. The broad approach of social medicine also overlaps with a study on this field of human geography. The current situation in the Indian sub-continent is interesting. Malaria is controlled over almost all this vast and populous area and eradication is now planned. Tuberculosis may be controlled by BCG within a few years. But the intestinal diseases, the universal infectious diseases mentioned earlier, and especially the still deplorably high infant mortality rates are surely subjects for an attack integrated with all-round development, on the lines of the Community Development projects which have gained some successes but are also causing much anxiety towards the close of the Second Five Year Plan. The topic is none the less worthy of study, but on this scale the indication is surely for team work. In a sense social medicine is community development, or, as you will, social medicine is regional planning.

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DISCUSSION

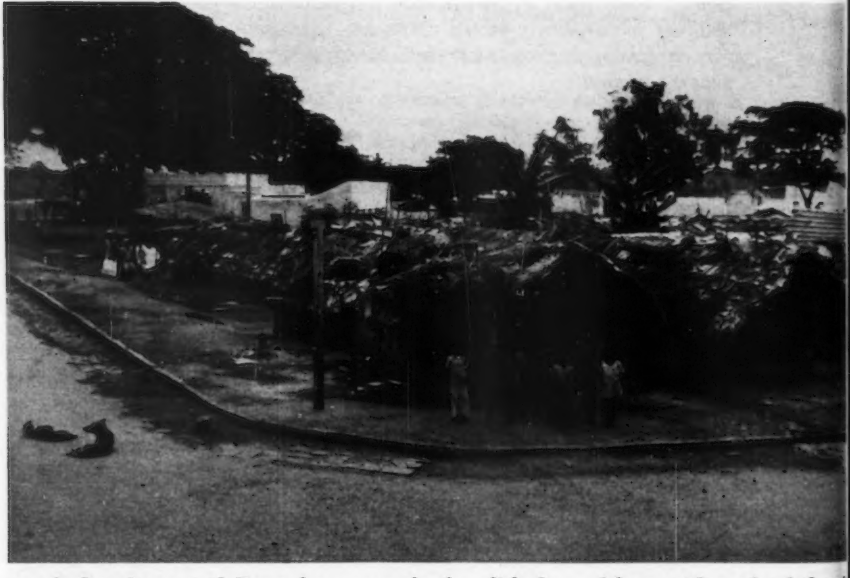
Afternoon Meeting, 7 March 1960

The CHAIRMAN (Professor L. DUDLEY STAMP): This afternoon we are to have the initiation of a discussion in the very important field which we have come to call, perhaps unwisely, medical geography. Perhaps it would be better described as the geography of pests and diseases. Just as a statistician is concerned with the statistical analysis of facts relating to a wide range of studies, so we as geographers are concerned

1. Dandhalli near Fraserpet, Coorg: terraced, one-crop paddy, homesteads dispersed within woodland margin, trees shading cooperatively owned cardomon. Foreground: shelter for cardomon nursery plot; left background: savanna-like grazing ground

2. Hadahi near Davangere; masonry or brick houses of the tank country

3. Halenahalli, near Tumkur, a separate hamlet for Harijans. Compare house-type with plate 2



4. A slum in central Bangalore, recently demolished; mud huts with roofs of thatch or kerosene cans, or sometimes tiles

with the distributional aspects, particularly the distributional aspects portrayed on maps, in a wide variety of fields, which includes the study of pests and diseases. I say this because it might be misunderstood that we, as geographers, are trespassing into the field of the doctors. That of course is very far from being the case and I think you will see from the paper which introduces our discussion that there is a real contribution that geographers can make. Dr. Learmonth is lecturer in geography in the University of Liverpool, but for two years he was in India at the invitation of the central Government to assist in some of the great work of survey for planning purposes under the Five Year Plans, which the Indian Government has initiated. His particular area has been the State of Mysore, but he travelled extensively, and in connection with his work of survey for planning he found himself (as almost anyone in India must do) concerned with the question of health and disease in the people of that so highly populated country.

Dr. Learmonth then read his paper

THE CHAIRMAN: I think I am justified in saying that in all parts of the world now there is a growing band of those who are interested in the geographical aspects of the distribution of disease. I would like first to call upon another of those in this country who has much concerned himself with this field, Dr. Melvyn Howe, of University College, Aberystwyth.

Dr. G. MELVYN HOWE: Despite the fact that diseases have been widely studied by our medical colleagues and biologists, little is known in many cases of the details of their geographical distribution. Yet, until more is known of these distributions we are not really in a position to appreciate fully many of the factors which are operating to make some diseases more prevalent in one place than another. The mapping of morbidity and mortality data relating to different human diseases provides a wide and fascinating field of study for the geographer, from which distinct regional patterns and relationships with factors of the physical and cultural environment may well appear.

The areal viewpoint of the geographer and his experience in integrating the varied and numerous aspects of the total environment should make him a most useful collaborator and team member for many medical research projects. The medical specialist not unnaturally approaches his problems through genetic and clinical research in the laboratory, but it seems to me that the geographer, with the unity of man and nature in mind, might well make the examination of geographical distributions of diseases in relation to physical and social phenomena a very worthwhile field of study. I believe his coordinating functions and cartographical interpretations to be not only acceptable but welcome by the medical profession.

In this context it has been a matter of considerable surprise to me that more has not been done about the geography of disease in this country where reliable and accurate statistics are available (so very different from those available to Dr. Learmonth!). We are still not in possession of a basic atlas of diseases, let alone a series of maps made at intervals to show changes in distributional patterns resulting from various curative measures, or migrations of people associated with rural depopulation or the development of new industries in certain localities. I hope that with the support of the Royal Geographical Society's Committee for Medical Geography we shall be able to correct this situation by the preparation of such an atlas of diseases for the United Kingdom.

My work in the field of medical geography has been concerned mainly with the geography of diseases in England and Wales. So far I have concerned myself with the mapping of standardized mortality for some of the more common diseases. The mapping of crude death-rates would probably merely reflect the map showing the distribution of population, but the standardized mortality ratio, which involves a standardization of local deaths in terms of age structure and sex, enables comparisons to be made of mortality in local areas with that for the country as a whole.

Distinct regional patterns of disease have been revealed by the mapping. For instance the distribution of bronchitis and of lung-bronchus cancers shows the expected urban relationship. But not so for cancer of the stomach. [Dr. Howe showed a slide

of a new map of the distribution of mortality from stomach cancer in females based on standardized mortality ratios for each County Borough and for the urban areas and rural areas of each administrative county in England and Wales.]

North and West Wales show very high ratios for stomach cancers for females—and for males. Why should this be so? The overall dominance of the O blood group in the population of Wales is well known, but whereas the greater part of North and Mid-Wales has O gene frequencies of over 70 per cent, frequencies fall to 59 per cent in local areas in South Wales. Is there, therefore, any hereditary predisposition of people of the O blood group to this disease? Aird, Bentall and Frazer Roberts have drawn attention to a statistically significant association between cancer of the stomach and blood group A. But it is the "Little England beyond Wales" on the south-east side of Milford Haven which has the high A gene frequency and not the North and West of Wales. Geographical distributions would seem to support instead Balme and Jennings, who suggest that the excess of the A blood group applies to cancers of the pylorus of the stomach (which constitute the majority of gastric cancers), but that there is an excess of the O group and a decrease of the A group in cancers of the body of the stomach.

Is it a question of inbreeding (so common in North and West Wales), or are there correlations—directly or indirectly—with other environmental factors like soils deficient in micro-nutrients or the water supply, which in the rural areas is untreated and not infrequently chemically polluted from spoil mounds of defunct lead-silver mines? Even in 1960 a surprisingly high proportion of the farm water supply in West and North Wales is unpurified and unpiped.

I would suggest that the mapping of diseases to show areal relationships may help in the difficult early stages of certain medical problems. The regional confinement of many diseases may well parallel aggregations of population or the secondary effects associated with aggregations such as atmospheric pollution, sanitation, etc., or with such factors as marital state, blood groups, diets, climatic factors, soils or water supplies, most of which can be depicted in map form. In the mapping of these and like phenomena the geographer can claim some expertise and this, together with his sense of regional variation, should make him a useful collaborator in many medical projects.

The CHAIRMAN: Thank you, Dr. Howe, for reinforcing the points which have come out from the maps of India, on the purpose of mapping—to produce the factual statements which pose the questions.

We are very fortunate this afternoon in having as a guest amongst us Professor George Macdonald, who is director of the Ross Institute and Professor of Tropical Hygiene in the University of London.

Professor GEORGE MACDONALD: Dr. Learmonth is to be congratulated on his masterly exposition of this subject, within which the geographer, the biometrician and the epidemiologist attempt to meet each other, though often without much success. There is much to be gained from the study of historical and geographical pathology, but it is hampered by the difficulty of communication between people of the disciplines concerned, and the rarity of appearance of anyone competent in all. This is so much the case that Hirsch (1883) remains the standard work. It contains a great mass of information which is, however, unlikely ever to be brought up to date within its previous form. There has been much recent experimentation which has chiefly taken the shape of cartographic presentation of epidemiological material. These efforts are still experimental, the authors are still struggling to represent a great variety of such subjects on a map, and sometimes they fail through the effort to present too many, too profuse and occasionally too irrelevant subjects.

Dr. Learmonth's presentation is particularly interesting in that he has managed to present a sufficient variety of information without confusion. He uses a code which is perhaps a standard one to geographers, but which is new to me. Like any other code it has to be studied and understood but, this being done—and it is quite simple—it can be readily memorized, and maps drawn in it can be quickly interpreted to give a clear understanding of both the prevalence and variability of happenings.

He has taken these two aspects of prevalence and variability as significant charac-

teristics of disease. The use of variability for this purpose requires no excuse and I myself would pay even more attention to the subject than he does. Epidemiological happenings can sometimes be described more accurately, and explained more readily, in terms of the stability or instability of the infection, than in terms of incidence in any one year. Variability is one of the prime characteristics of epidemiology, the degree of fluctuation about the mean being more closely related to other epidemiological features than the mean prevalence itself. Malaria in the area he describes is present in a very unstable epidemiological form; and its other local manifestations would correspond quite closely with those in another place of equal instability, though they might be markedly different from those in another place with the same average intensity but less variability.

This characteristic of variability, dependent on environmental conditions, is a prominent feature of the epidemiology of most diseases. Some of it is irregular and some of it periodic or cyclical. These cyclical changes have been well documented in the case of measles—a disease which can be conveniently studied and which fluctuates in England on a 92- or 93-week period. They occur in many other diseases: *Kala Azar* depopulated a large part of north-east India in a course of epidemics on a 30-year cycle; malaria recurs in similar cycles in many parts of the world, the notorious one-time epidemics of the Punjab happening on an 8-year cycle—as did also those which once characterized a large part of Ceylon. Collection of this type of material can, therefore, be of very particular interest.

I have also appreciated the demonstration of the connection between the prevalence of some of these conditions and climatic happenings. In malaria and many other diseases with an obligatory stage of external development in a mosquito or other host, transmission is often closely related to temperature and also to humidity, which has an indirect effect on the carrier. A map of India showing by contour lines the number of months in any area in which both the mean temperature exceeds 70° F and the 8 a.m. humidity exceeds 70 per cent, corresponds very closely in its sub-divisions with a map of the epidemiological types of malaria, such as that published by Christophers and Sinton (1926).

It is only by this form of cartographic representation that many important associations can be discerned, and I sincerely hope that Dr. Learmonth will pursue the very interesting studies on which he has already made such a substantial start.

The CHAIRMAN: While talking about variability one naturally thinks as a geographer of variability of climate and weather conditions from year to year and the fascinating picture which your words produce, of the possibility of actually doing some maps of incidence of particular diseases for one year and of plotting at the same time, climatic factors, and becoming once more determinist geographers. But that is just an indication to my mind of the immense work which there is still to be done. I think, Professor Macdonald, you would agree that we have been talking this afternoon almost exclusively about mortality. Not everyone that suffers from a disease dies from it, and the whole question of morbidity statistics seems to me a very interesting one. The incidence of actual illness, which causes so much loss of time and energy, is another sphere waiting to be investigated.

I see Mr. Farmer, whose work on Ceylon we know so well, and I will ask him if he will come come forward. Mr. B. H. Farmer, of the University of Cambridge.

Mr. B. H. FARMER: I would like, if I may, to make three comments. The first is purely factual. I was interested to be reminded of the pattern of endemic malaria on the mainland of the Indian continent and of the very close correlation between endemic malaria and high rainfall. In Ceylon, on the other hand, there is no such correlation. Before its virtual conquest by D.D.T., endemic malaria was confined to the Dry Zone. I suppose that this situation, curious by Indian standards, is related to the fact that there is only one vector, *Anopheles culicifacies*, which likes still, sunlit pools such as those formed by the dwindling Dry Zone rivers. In the Wet Zone, on the other hand, any mosquito which lays its eggs in the perennial streams has them swept out to sea, and it is only in a year of drought when rivers dwindle to pools that an epidemic of

malaria ensues. Perhaps Dr. Learmonth can tell us briefly about the vectors and any other factors there may be in these wet highland areas of his in Mysore.

The second point is, I suppose, a methodological one, although that is a very long word for the very simple point that I want to make. Then there is, if I may coin a phrase, Mr. Chairman, a wind of change blowing through the geographical world these days, and one of the forms it takes is an insistence on the greater use of statistics. That may not in itself be a bad thing; but there is a need for caution. We should remember that no statistics are better than the basic data on which they rest; and basic data from the Indian sub-continent are sketchy in the extreme. One suspects that a great many of the data about morbidity and about causes of death are particularly shaky.

The third point is one that I am sure has been made many times before. It is that if phenomenon A has a pattern on a map which is similar to the pattern of phenomenon B, then phenomenon A and B are not necessarily causally connected. We have seen Dr. Learmonth establish a highly credible chain of causation that stretches back from the high incidence of intestinal diseases to particular kinds of wells and beyond that to particular kinds of geological and geomorphological conditions. But clearly no such chain of causation has been established between many of the phenomena that make patterns on Dr. Learmonth's maps.

The CHAIRMAN: Well, Mr. Farmer has raised the question of validity and treatment of statistics. We have Dr. Wise with us this afternoon, a medical statistician: can he add a word on the statistical aspect?

Dr. WISE: I am afraid, Mr. Chairman, I have not prepared anything, but there are several points that are possibly of interest.

My work concerns radiation hazards. At the moment we have at least three fascinating problems involving geographical knowledge. The only real evidence that radiation does any damage to people comes from human data. One example is genetic damage. There is very little direct evidence for this, except from geographical studies. Recently in America Wesley has published an article in the *International Journal of Radiation Biology* (Wesley, 1960). He shows that the incidence of malformation is well correlated with the geo-magnetic latitude, the point is that cosmic rays are distributed with the greatest intensity in a region round the magnetic poles; there is an increase in the cosmic ray intensity even at sea level from the geo-magnetic equator to about 40° from the north magnetic pole. The intensity in the tropics is low. This is just where the incidence of malformation is very low. This is a really important case when one needs a geographer, because there are so many other things that are different in places with high and low magnetic latitudes, in order to sort out the real effect of cosmic rays apart from other factors in the environment. In Europe, for instance, from Wesley's analysis, the greatest incidence of death in childhood due to malformations is about 8 per 1000 live births in Northern Ireland, and in South-east Asia it is less than 0·1 per cent. Now one possible catch there is that we have not allowed for altitude. I wonder if there are any countries where most people live at a high altitude, like Ecuador, from which useful data could be obtained.

Another example is the incidence of bone cancer in America. There was a recent study of the geographical distribution of incidence by Bugher and Mead (1959) and they obtained standardized mortality rates in places where there is a high background of radiation—such as the Rocky Mountains—and then compared them with low background regions. They found that the Rocky Mountains and the Far West had *lower* incidence than the rest of the U.S.A. (not higher as it would be if background radiation was causing the difference). The map of incidence they obtained looks extraordinarily like a smoothed out rainfall map of America. Again I do not know whether this is cause and effect, I have not studied this enough, but it is worth while to state the problem. A fuller account, dealing also with geography and leukaemia, is now in the press (Wise, 1961).

Can I make a general comment about applying medical statistics and mapping in this field? I am worried about one thing at least. In most incidence problems in medical statistics we are plagued by uneven standards of diagnosis, and especially by

differences between urban and rural areas which may have nothing to do with the factor (concerning the disease) that we are studying. But apart from those differences nearly every disease seems to show a real difference in incidence between urban and rural areas; also many show difference between social classes. I do not see how you can get all these effects into one map. I am worried about these maps of incidence when they try to show everything. On the other hand, maps of one kind of region, say of incidence in rural districts alone, or in any kind of comparable population, might show very much more.

The CHAIRMAN: Dr. Wise has brought us up against a problem which I am sure we are facing in so many directions: the contrast between urban and rural. The subject is now open for discussion.

Dr. ROBERTS (Department of Human Anatomy, Oxford): In mapping distributions of biological phenomena there arise, from the very nature of the data, a number of difficulties to which geographers have given too little attention, despite the pleas for help that have from time to time been voiced—for instance in the symposium organized by the Royal Geographical Society several years ago. Biological variability is responsible for many of these difficulties, and variability due to a particular source often requires to be examined for its own sake. Dr. Learmonth is to be congratulated on what is a marked step forward in technique, his ingenious method of portraying both mean and variability on the same map.

The criticism is sometimes heard that in medical geography the geographer's role is that of a mere technician. Nothing could be further from the truth. In this field he has to make decisions that can in no way be regarded as purely technical, concerning what to map, how to map it, and how to interpret what he finds. For instance, in examining the distribution of malaria, is he to map malarial mortality rates? Or the incidence of clinical cases? Or parasite rates? Or parasite counts? Spleen rates and haemoglobin levels certainly must be included. He has to look outside his immediate topic for other possible relevant factors. When looking at the distribution of, say, sickle cell anaemia with its near 100 per cent mortality in African children (a molecular disease in individuals homozygous for the gene responsible for producing haemoglobin S instead of the normal adult haemoglobin) he needs to consider in the first place the distribution of the sickle cell trait, the heterozygous manifestation of the same gene, which in some African populations reaches a frequency of about 40 per cent, while in others it is absent. If then he finds that there is a close correspondence between the map of the sickle cell trait and the map of malarial endemicity, with high values of the trait occurring in hyperendemic areas and low values where malaria is absent or epidemic, has he the necessary knowledge to make the correct interpretation, that the geographical correlation probably indicates that the sickle cell trait individual is to some extent protected against the worse effects of malaria? The chain is thus high endemicity of malaria, responsible for high frequencies of the advantageous sickle cell trait, which in turn by the very inheritance of this character produce higher incidences of mortality from sickle cell anaemia. This illustrates the severest criticism that the medical geographer has to face—that he may not have adequate biological knowledge to enable him to look for the relevant factors or to make valid interpretations.

This criticism can of course be met. The geographer by his training is habituated to collating data from a variety of disciplines. He who intends to undertake research in, say, geomorphology prepares himself by thorough grounding in subjects ranging from geology to the physics of wave motion or glacier flow, and in this his work is facilitated by the arrangement of many advanced school and university courses. The intending biological geographer has no such advantage, but nonetheless prepares himself in human biology, ecology and other relevant subjects though he does not pursue a full clinical course. It may be that he serves, as it were, a biological apprenticeship outside a geographical department, or works as a member of a research team, and in the course of his research makes constant reference to other specialists. So that when the time comes for him to publish his distributions and interpretations he is, like our lecturer today, adequately prepared to defend them.

Now why is the geographer interested in doing this? There is for him an intrinsic interest in biological geography, for in few fields can there be traced such close relationships as exist between some manifestations of disease, some measures of health, some biological characters and the environment in which the population lives. There are well established in the medical and geographical literature instances of important effects of individual geographical factors, the analyses of which intrigue him. Their identification leads to a much fuller understanding of the human geography of a region. Finally, he has a further extremely important role to play. He examines geographical distributions, from which he sets up hypotheses of correlations between biological and environmental factors; these hypotheses may depart quite widely from accepted biological thought—hence the need for sound preparation. But these hypotheses can then be tested by experimental procedures by others more competent in their own specialities; and if they are validated experimentally, then the geographer has made a worthwhile contribution to the advancement of knowledge.

The CHAIRMAN: I will now call on Dr. Learmonth.

Dr. A. T. A. LEARMONTH: Taking the points in order, and being as brief as I can be, I do agree wholeheartedly about the importance of variability and its worthwhileness in study for its own sake. I should think, perhaps, that isolating it was the kind of thing to do in a study in depth rather than the kind of broad survey that I was trying to make in the two projects that I have attempted in respect of the Indian sub-continent. But I can see that it would be a very valuable field. With regard to morbidity (our Chairman's contribution) I fully agree, and I think that this again is a field in which we could make a beginning in Britain. I think perhaps a body like the College of General Practitioners, if indeed we could win them over to cooperate, might well help us to get at really worthwhile, mappable morbidity figures which might be full of fascination, and of course may be even of practical use as well.

The Ceylon drought and the big epidemic is indeed a fascinating story. It is true that endemic areas in India are within humid India, but there are, within humid India, areas where the local vector dislikes wet conditions just as *Anopheles culicifacies* dislikes the humid part of Ceylon and only goes there in a drought year. The State of Mysore has got at least two main vectors, one is *A. culicifacies*, the still-water breeder in the tanks; there is also the stream-breeding forest mosquito in clear forest streams, *A. fluviatilis*.

Poor data are always a problem. But if the topic is an important one, we should avoid simply doing nothing, but should rather use appropriate caution and use appropriate methods, and one should not, of course, profess to have got all the way. I agree that one must not use mere areal correlation as being enough, and that one must, to be really satisfied, understand the ways in which the causal links work through.

Dr. Wise's contribution I find most stimulating, both in relation to today's subject and also to various quite different problems which one might tackle. His specific point referring, perhaps, especially to this afternoon's discussion, about the uneven nature of data, is most valuable—i.e., that urban and rural data should be kept separate. I would say that at the scale at which I was operating, as a sort of part-time researcher, I was perhaps right to go on just at that stage of the work, because certainly in the period of study India was still so largely rural that one could probably get sufficient comparisons to give a first grasp of the problem. But I agree that this is a most interesting and likely to be a most useful technique.

Dr. Roberts, as always, has produced enough ideas to keep us all busy for ten years or so. It was a most interesting and stimulating contribution. I do not think that there is any sort of discordance really between the possibility that a geographer may contribute to this field as a member of a team, or on a particular project, but should also retain an unashamed interest in the thing as a branch of human geography. I hinted that this was my own approach and it could, of course, be carried out in a much more wholehearted and thorough-going fashion, given time. It may be that what this field perhaps needs more than anything is some full-time research by people who have approached it from the geographical side of the problem.

THE RIGHT HONOURABLE SIR HALFORD J. MACKINDER, P.C., 1861–1947

E. W. GILBERT

THE CENTENARY of the birth of Halford John Mackinder occurs this year. He was born at Gainsborough, Lincolnshire, on 15 February 1861, the eldest son of a doctor. As he lived to the venerable age of 86 it is still only fourteen years since his obituary appeared in the *Journal* (*Geogr. J.* **110** (1947) 94–9). There is therefore no need to repeat the story of the many-sided life of this great British geographer, but it is appropriate to remember his connections with, and services to, the R.G.S.

Mackinder's election to the Society was proposed by H. B. George, Fellow and Tutor of New College, Oxford, author of several books on historical geography, and seconded by Douglas Freshfield, later to become President of R.G.S. in 1914–17. The date of Mackinder's election was 22 March 1886, and he continued as a Fellow for the remainder of his life, that is for more than sixty years.

Eight of Mackinder's thirty papers were published in the *Journal* and these give some indication of his main geographical interests; three of them are concerned with geographical education. In January 1887, during his first year as a Fellow, he lectured to the Society by invitation "on the scope and methods of geography" (*Proc. R.G.S.* 9 (1887) 141–60). This lecture was a remarkable and audacious performance, when it is remembered that Mackinder was only twenty-five years of age and still a B.A. It is said that an Admiral, a member of Council, who sat in the front row, kept on muttering "damned cheek" throughout the lecture, but in the discussion Francis Galton prophetically remarked that Mackinder "was destined to leave his mark on geographical education". Another paper on academic geography, "Modern geography, German and English", was printed in the *Geogr. J.* **6** (1895) 367–79. This had been delivered in September 1895 as a Presidential Address to Section E (Geography) at the Ipswich meeting of the British Association. The third paper on education, "Geography as a pivotal subject in education", was read at a meeting in the Society's map room in March 1921 (*Geogr. J.* **57** (1921) 376–84).

Two of Mackinder's papers record his own work as an explorer. In 1898 when Mackinder still held teaching appointments at both the University of Oxford and University College, Reading, he decided to make an expedition to East Africa because he believed "at that time most people would have no use for a geographer who was not an adventurer and explorer". He spent the long vacation of 1898 climbing in the Alps and in the summer of 1899 he made the first ascent of Mount Kenya, a feat which he described in *Geogr. J.* **15** (1900) 453–76. Thirty years later he gave a shorter but vivid account of this expedition at the Society's centenary celebrations (*Geogr. J.* **76** (1930) 529–34). This address was one of a series of papers by British explorers on special incidents in the history of exploration.

Mackinder was deeply interested in political geography and especially in the application of this subject to the British Isles and to the Empire. Two of his papers in the *Journal* are concerned with these topics. The most famous of all his papers, "The geographical pivot of history", was read to the Society in January 1904 (*Geogr. J.* **23** (1904) 421–37). In the discussion after the lecture Spenser Wilkinson called attention to the two main doctrines which Mackinder had laid down. The first was that the world had become one and in so doing had also become one political system, but the second and main point which he thought Mackinder had made was "the

enormous importance to the world of the modern expansion of Russia". This classic paper with its theory of "the natural seats of power" deserves re-reading at the present time even though it was written nearly sixty years ago. Lesser known is a paper read by Mackinder to the Society in March 1908 on "Geographical conditions affecting the British Empire, I. The British Islands" (*Geogr. J.* **33** (1909) 462–79). No further part of this projected series was printed.

In 1935 Mackinder delivered his last paper to the Society, in which he combined his interests in academic geography with those in exploration: "Progress of geography in the field and in the study during the reign of His Majesty King George the Fifth" (*Geogr. J.* **86** (1935) 1–12). This address was given at the time of the Silver Jubilee of George V. In this lecture he returned to a theme which he had developed in his first lecture to the Society, to what he called "the bridge character of geography". Already in 1887 he had deplored that "the greatest of all gaps lies between the natural sciences and the study of humanity", and asserted that it was "the duty of the geographer to build one bridge over the abyss". In 1935 he argued that the function of the philosophical geographer was "to integrate and not merely to accumulate knowledge. His aim is so to digest the results of specialised research that they become available as a contribution to the assessment of values. Only so does it seem to me that science itself can be adapted to the bridging of the gap between science and values, which gap is admitted to be a danger to civilization."

Mackinder made many other contributions to the *Journal* in discussions, letters and reviews but it is not possible to list them all here; they can be found quite readily from the index volumes. But two examples of recurring themes may be given. He often pleaded that geographers should be precise and simple in their writing and should not employ technical jargon. In 1909 during a discussion after a paper by Professor W. M. Davis he said: "It is no doubt easy, when you are talking to experts, to describe with precision by the use of technical jargon. It is a very hard thing to write a good plain English sentence. But if we adopt the easier method, and shirk the harder, then geographers are throwing away a great opportunity which lies before them." (*Geogr. J.* **34** (1909) 321.) At the same time Mackinder expected surveyors and cartographers to understand the science of land-forms. In *Geogr. J.* **21** (1903) 195–8 there is a letter from Mackinder in which he severely criticized the cartographic methods employed in a map published in the same volume of the *Journal*. He concluded this letter by asking "is it too much to expect that geographical surveyors and map-makers should have mastered at least the outlines of the science of land-forms? The artist who depicts the human form finds it necessary to know so much of anatomy as is needed to explain the contours of the body."

Mackinder's services to the Society cannot be measured by his published papers only. He was a member of numerous committees; he served on the Council from 1909 to 1912 and from 1928 to 1936, and was Vice-President from 1932 to 1936. He never became President, and the severe deafness which afflicted him in later years made his election to that office virtually impossible. In 1945, with the approval of His Majesty the King, he was awarded the Patron's Medal. At the age of eighty-four he made an impressive speech thanking the President for the honour conferred upon him (*Geogr. J.* **105** (1945) 230–2). Mackinder's work took him into many different fields outside the teaching and writing of geography. He was one of the Oxford pioneers in the movement for adult education by means of university extension lectures; as an administrator he helped to found a college which eventually became the University of Reading, and later he was Director of the London School of Economics; as a politician he had a seat in the House of Commons (as Unionist member for Camlachie, Glasgow, from 1910 to 1922) and served on Royal Com-

Halford John Mackinder

Portrait drawn by Sir William Rothenstein in 1933; reproduced by courtesy of the London School of Economics

missions and as British High Commissioner for South Russia in 1919–20. In spite of these diverse activities his affectionate devotion to the Royal Geographical Society and the furtherance of its interests remained constant throughout his long life.

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THE JEBEL MARRA, DARFUR, AND ITS REGION

J. H. G. LEBON AND V. C. ROBERTSON

DARFUR, THE WESTERNMOST province of the Republic of Sudan, extends from the desert in the north deep into the great east–west savanna belt of northern Africa. But, in the midst of the almost featureless monotony of the African plateau, and gradual, almost imperceptible transitions in natural vegetation, it is given coherence by the substantial volcanic upland of Jebel Marra, from which radiate watercourses to the Nile and Lake Chad basins; a geographical skeleton for much of the province, upon which depends a flesh of soil, vegetation, agricultural and settlement distributions. This mountain, then, is the origin and focus of much in the geography of the plateaus around, and the two form essential, though contrasting, elements of a true geographical region which, for lack of space, will not be explicitly delimited. Attention to the maps on the folding sheet will readily suggest where parts at least of its boundaries might be drawn. Remoteness, in the very heart of Africa, delayed exploration and the process of being brought under modern administration and commercial development. Darfur was not incorporated finally into Sudan until 1916, and could be reached only by camel transport until about 1930. From that date the motor lorry came into use; and since the Second World War regular air services have connected Khartoum within the day with El Fasher, Nyala and El Geneina. A railway extension reached Nyala last year. The province is thus much more accessible than formerly, and the authors of this paper have been able to visit and study considerable areas during the past four years. Their work has been greatly aided by air photographs taken by the U.S.A.A.F. in 1943–4 and by the Sudan Survey Department (for central areas) since 1957. During visits to areas selected for study, indispensable help and great kindness has been received from the Sudanese provincial administration which is gratefully acknowledged. The senior author has also received grants from the Research Fund of the University of Khartoum. Grateful acknowledgement must also be made to the Ministry of Irrigation and the Forest Department in Khartoum; and to the authors' colleagues Mr. A. N. Burton, Mr. D. O. Hughes and Mr. D. A. Francis, whose work in the field has been extensively drawn on, especially in relation to geology and hydrology.

Essentials of geology and land forms

The Jebel Marra itself is an extinct, late-Tertiary, volcanic massif rising to a maximum elevation of 3042 metres. It is a lofty and rugged range, aligned north–south for a distance of some 55 miles and at its maximum some 40 miles wide. It is continued northwards for another 60 miles in smaller uplands. To the north-east are the detached Tagabo Hills and Meidob plateau, the former partly, the latter wholly, of similar origin. It appears that this complex of old volcanoes rests on a base of Archaean rocks at the summit of an upwarping between the Chad and the middle Nile basins. This plateau, which stretches westwards to the frontier of Sudan and beyond, is an undulating peneplain composed of Archaean rocks, usually called the Basement Complex in the geological literature of Sudan. Its elevation varies between approximately 1100 metres in the east and 600 metres in the west. Isolated hills (inselbergs) and ridges rise above this peneplain. The highest is the Tebella massif (1413 metres). It seems probable that these hills are remnants of a

higher and older erosion surface. To the south-east and south of the Jebel Marra the plateau is maintained at an altitude of about 600–700 metres, though at distances varying from 15 to 70 miles from the foot of the mountain Archaean rocks disappear beneath superficial deposits of sand and clay. As in the west, it is diversified by small uplands and inselbergs, including the Dagu Hills and the Gennung Hills (1200 metres).

The Archaean plateau

To the east and north of Zalingei the Basement Complex rocks are predominantly acid crystalline schists and gneisses, characterized by the mineral biotite, and generally exhibiting complex injection phenomena. These rocks are generally coarse-grained and often resemble granite. They weather very readily in the prevailing high temperatures and seasonally heavy rainfall, and generally form low ground with gentle slopes.

In contrast, west of Zalingei the rocks are predominantly paraschists and gneisses. These rocks consist of calc-silicate gneisses, fine-grained biotite granulites with garnets, graphitic rocks, garnetiferous micaschists and staurolite schists. A group of schists characterized by the mineral muscovite occupies a considerable area in the extreme west. Most of these rocks are resistant to weathering and generally form deeply dissected hill ranges. Just to the west, the Wadi 'Azum has cut a rocky gorge through such rocks, north of Dereisa. Isoclinal folding of granulitic gneisses interbedded with quartz-muscovite schists can here be seen in the magnificent vertical sections displayed on both sides of the gorge.

South of the Tebella massif the basin of the Wadi Debarei appears to be a synclinal trough intruded into, and to a considerable extent occupied by, foliated and unfoliated granite. This area is characterized by isolated hills (inselbergs).

Investigation of the area east of the volcanic range has been less thorough. Field geologists of the Geological Survey, Sudan, have been recently at work in the areas near El Fasher and Nyala, but their maps and memoirs have not yet been published. The Jebel Nyala, which is a prominent landmark close to the town of the same name, and the Dagu Jebels, to the north-east, are granitic. The Wana Hills, north-west of El Fasher, which present a bold, possibly faulted, scarp to the south and south-west, and the plateau between Nyala and the foot of the Jebel Marra, are composed largely of gneisses. In the area about midway between El Fasher and Nyala, and farther east in the same latitude, rocks are predominantly quartzose.

At about 100 miles eastward of the Jebel Marra range the Archaean rocks become covered by Nubian sandstones. Evidence (in the shape of outliers) of the former westward extension of this formation (presumably before the commencement of the volcanic activity producing the Jebel Marra uplands) exists near El Geneina, Garsila and, east of the watershed, at several places not far from the El Fasher–El Geneina road, about 60 miles west of El Fasher. Other small outliers occur about 60 miles north-west of Nyala, near Keila, Melem and Menawashei. The recent geological surveying has provided evidence suggesting that Nubian sandstone may be extensive south-west of El Fasher, beneath superficial wind-transported sand. It was previously thought that this sand rested upon the Archaean plateau. The only other sedimentary deposit recorded within the area of the Archaean outcrop is a bedded limestone near Zalingei, which is believed to have been formed from lime-bearing waters emerging from springs.

The Jebel Marra volcanic complex

Andrew (1948) states that volcanic activity is generally thought to have begun in Upper Tertiary (Miocene) times. The crater of Jebel Marra (called in the vernacular

Deriba) is probably Recent. This is a culminating feature of the range. It is rather more than 3 miles in diameter and contains two lakes: a larger, shallow and very saline lake occupying much of the north-eastern part, and another occupying a subsidiary crater to the south-west. The latter, which is probably very deep, is much less saline than the other. The floor of the crater is at an elevation of about 2500 metres whilst the serrated rim rises above 3000 metres. Many lava peaks rise from the high plateau north and east of the crater. Some of these are very imposing: one, Uwofuo, is probably the highest point of the range. The history of volcanic activity in the main range may be analysed in several phases:

(*a*) During the first phase lava was erupted more or less continuously. Its composition varied from olivine basalt to trachyte; and the earliest flows were the most basic. The first outpourings of olivine basalt were extremely fluid and flowed long distances before solidifying. One flow, probably following the then existing course of Wadi 'Azum, reached a point only 18 miles from Zalingei. Later flows became progressively more acid and therefore less fluid. These solidified closer to their source, forming a lava mountain which is the core of the present range. The existing relief of the Archaean plateau must have influenced the flow of the lava. Thus, the broad lava lobe projecting westwards from Nyertete on the west flank of the present mountain probably occupies a pre-volcanic depression and its flow was barred north and south by ridges diverging north-west and west from Guldo and Kalokitting.

(*b*) An interval followed during which the newly-formed lava mountain was subjected to intense sub-aerial erosion. Coarse-grained, current-bedded alluvial deposits occur both to the west and the east of the mountain, which were probably deposited in basins on the flanks of the volcano, either before a new drainage system had been established, or because of damming of established channels. Extensive alluvial deposits were also formed at the foot of the mountain. The extent and nature of this "piedmont alluvium" is described later. The numerous isolated volcanic necks or plugs now occurring at a distance from the main volcanic massif presumably lost the attendant constructional features of new volcanoes during this phase.

(*c*) A second eruptive phase then occurred, during which small quantities of basaltic lavas were erupted. These lavas may have issued from subsidiary vents on the flanks of the main volcano. They can be observed to lie upon piedmont alluvial deposits; near Kronga, coarse alluvial deposits and lava are interbedded.

(*d*) An explosive phase, during which much volcanic tuff was deposited and the large existing crater formed. Most of the tuff on the western side of the mountain appears to consist almost entirely of fragments of pumice, but tuffs of trachytic composition also occur. These tuffs are easily eroded into typical "badland" relief.

(*e*) The correlation of the outlying smaller volcanic areas with these phases has not been studied. One special feature requiring attention is an intrusive phase represented by dykes near Kutum.

Superficial deposits

Superficial deposits of both fluviatile and aeolian origin are widespread. The Wadi 'Azum and its chief tributaries flow in broad channels composed of coarse sand, which are dazzling white during the dry season. They are fringed by discontinuous flood-plain terraces and by more fragmentary higher terraces. Air photographs of

the W. Kaja basin just east of El Geneina strongly suggest that similar terraces may extend for some 15 miles south of the main channel and about 10 miles to the north; alternatively, there may be colluvial deposits, or perhaps even a thin aeolian sand formation. Field-work is required to determine the exact nature and origin of these deposits which, as will be shown later, sustain an important cultivated area. The eastward and south-eastward flowing rivers, likewise, flow in sandy beds for considerable distances from the mountain; and in many places silty terraces may be discerned, though no mapping has yet been undertaken. But at distances varying from 30 to 50 miles from their sources the coarse sand changes to silt.

A large single silt or clay plain lies north-east of Kutum and of the whole volcanic range. It is traversed by the road from Kutum to Karnoi Wells. When studied by means of air photographs its appearance is seen to differ from other alluvial plains farther south. The frequent dark patches where water stands after rain, outlined by salt encrusted margins, suggests a *playa*. Smaller silt areas have been identified in field reconnaissance north of the El Geneina–Kebkebia road, but not mapped. The piedmont clay plains are described later in the section on soils.

At distances varying from a few miles to about 50, from the eastern foot of the volcanic range, is the former *erg* or continental sand sea known to Arab speakers as the *qoz*. Formed during an arid phase of the Pleistocene, this immense expanse of sand still assumes the undulating relief of dunes, though now deprived of mobility by the prevalent savanna. Apart from the emerged summits of buried hills (Archaean, Nubian sandstone or Tertiary volcanic) the surface is singularly uniform. The continuity is, however, broken south of Nyala by the western extension of the Baggara type of terrain, in which clayey depressions, some elongated, are frequent. Also, the W. Ibra conveys the discharge of streams rising on the southern slope of the Jebel Marra to the Bahr el Arab. Yet farther south-west, the Qoz Dango continues the uniformity and expansiveness of the *erg*. It will have been realized that there is no counterpart to this sand sea to the west of the volcanic uplands. Only small areas of sand appear on the Archaean plateau north of the latitude of El Geneina.

Hydrology

It has already been remarked that the Jebel Marra range forms part of the eastern watershed of the Lake Chad basin. Almost all the west-flowing rivers of Darfur are comprised within the system of the Wadi 'Azum and its most considerable affluent, the Wadi Kaja. Within the basin of the Wadi 'Azum two considerable streams, the Wadi Debarei and the Wadi Saleh, join the main trunk in the extreme south-west. Both these tributaries drain catchments entirely composed of Basement Complex rocks. Another large tributary, the Wadi Barei, joins the Wadi 'Azum where it turns southward near Murnei. It drains a considerable catchment, again almost entirely of Basement Complex rocks, though at least one of its head streams rises on basalt on the north-west flank of Jebel Marra proper.

It should be noticed that many streams rising on the western slopes of Jebel Marra are often truly perennial for distances of 5–10 miles from their sources, and this is also true of some half-dozen eastward-flowing streams. Beyond these limits surface flow only occurs during the wet season (May–September), when both the lesser rivers and the Wadi 'Azum itself may flow continuously to a depth of several feet for periods of several days. Some very preliminary measurements of rainfall and discharge provoke some interesting speculation. (Hydrological studies continue at the present time.)

A number of springs were observed in the field during the dry season 1957–8,

within the outcrop of the volcanic rocks. Two springs to the east of Kronga were warm, but the remainder, located on the large Nyertete lava lobe, had normal temperatures. The water from these latter springs does not contain much mineral matter (total soluble solids determined from these and perennial streams below them ranged from 140–300 ppm) and is generally very clear. Springs of the western lava lobe have been observed issuing from honeycombed basalt, from the tops of lava flows, and from fissured zones on basalt lava. In addition to such springs, emerging from porous and permeable zones within lava formations, others might be expected to occur at the base of the lavas where they rest on the Basement Complex rocks, and also in the tuffs. The relief of the pre-volcanic surface could influence the location of the former group of springs, and subterranean streams supplying them might flow down the valleys in the buried surface. As the Nyertete lava lobe appears to occupy a depression in the buried surface, it may contain a large volume of this groundwater flow. This, if true, may be of economic importance. Springs rising in the tuffs may be rather saline, because this rock may contain a small proportion of water-soluble salts. At Kronga the inhabitants obtain salt by allowing water which has flowed over tuffs to evaporate in suitable containers. Water from the perennial stream at Kronga contained 2380 ppm of soluble salts which is strikingly greater than the mineral content of streams rising on basalt. The waters of the Deriba Lakes in the main crater also probably derive their salt from the same source but, as there is no outlet, the salt concentration increases. Even the smaller and fresher lake had a salt content of 4200 ppm—water from the larger lake contained nearly 14,000 ppm of soluble salts. It is unfortunate that water from the tuffs may contaminate purer water from the lavas.

The regime of the perennial streams is most relevant to their potential for storage and utilization. During the rainy season of 1957 a single gauge was established on a perennial stream. This was near Guldo on Wadi Buri, and its record is of great interest. It was first read in June, and at no time during the subsequent rains did the water reach the June level. The average basin rainfall at Guldo (computed from an adjusted isohyetal map prepared in 1958) was about 640 millimetres, representing a total rainfall of over 150 million cubic metres. It appears that none of this water found its way by direct run-off into Wadi Buri, so that, after allowing for evaporation and transpiration losses, the remainder must have percolated into the porous volcanic rocks to recharge the groundwater reservoir. If this kind of record can be continued for a period of years, important data will exist relevant to the best method of utilizing these waters. It is worth noting that, during the dry season 1957–8, the discharge of several perennial streams increased quite markedly. This lends support to the idea that delayed recharge from a sub-surface reservoir occurs. Therefore, in spite of low average porosity figures, it is to be inferred that basalt is generally a good water bearer. This is due to the many joints, fissures and caverns formed during cooling of lava, as well as the "honeycomb" structure developed in the upper crust by escape of steam and other gases from molten lava.

Seasonal rivers

Seasonal rivers on the western plateau are generally characterized by wide, coarse, sandy beds, low gradients (that of Wadi 'Azum between Zalingei and Dereisa varies from 1 : 600 to 1 : 1050) and sometimes extensive alluvial flood-plains and terraces. In 1957 some attempts were made to estimate the volume of water flowing in the Wadi 'Azum and two of its main tributaries, the Wadi Aribo and the Wadi Debarei. On the Wadi 'Azum, between Zalingei and Dereisa, a distance of about 80 miles, it is estimated that nearly two-thirds of an estimated flow at Zalingei of 90 million cubic

VEGETATION TYPES OF CENTRAL DARFUR

Montane

Upper montane zone of Jebel Marra, above 2000 m.: mainly open grassland, *Hyparrhenia multiplex*, with *Andropogon linearis* and, on summits, *Themeda triandra*. Scattered *Olea laperrini*; *Blaeria spicata* in crater and *Lavendula stricta* on tuff.

Lower montane zone of Jebel Marra, 1000–2000 m.: *Ficus* spp., especially *F. gnapholocarpa* and *Cordia abyssinica*, with grasses *Cymbopogon* spp., *Hyparrhenia pseudocymbaria* and *Andropogon gayanus*. Scattered *Euphorbia candelabrum*.

Upland gallery forests of the western perennial streams of Jebel Marra: *Anogeissus schimperi*, often in pure stands with closed canopy, with some *Ficus* spp., *Cordia abyssinica* and *Terminalia brownii*.

Woodland savanna of the western Archaean plateau

Anogeissus schimperi woodland savanna of the upper Wadi 'Azum basin, associated with *Acacia seyal*, *Lannea humilis* and *Albizzia sericocephala*, growing to average height of 6–7 m., occasionally to 12 m. Some thicket formation and commonly a shrub layer to 2 m., including *Grewia tenax*, *Combretum aculeatum* and *Cadaba glandulosa*. Grasses growing to 100–140 cm., mainly *Aristida* spp., *Chloris* spp. and *Eragrostis tremula*.

Boswellia papyrifera woodland savanna of hillier tracts, mingling gradually with *Anogeissus schimperi* woodland savanna. *Hyparrhenia* spp., *Beckeropsis* spp. and *Cymbopogon* spp. as grasses, with *Andropogon gayanus*.

Riparian and terrace woodlands of the Wadi 'Azum and Wadi Kaja main valleys: *Acacia albida*, sparse on flood-plains, dense, tall (13–15 m.) and forming a canopy on lower terraces. Shrub layer to 3 m., including *Grewia tenax*, *Cadaba glandulosa*, *Cordia ovalis* and *Dichrostachys glomerata*. Grasses often growing to 2 m., especially *Echinochloa colona* and *Pennisetum ochrops*. On higher terraces, transitional zone of *Balanites aegyptiaca* and *Ziziphus spinachristi*, mingling with woodland savanna of plateau. Variably degraded by cultivation and timber felling.

Acacia seyal woodland savanna of clay plains, often in pure stands, associated with *Setaria* spp. of grass.

Moderately tall grasslands of the western piedmont alluvium: *Beckeropsis uniseta*, *Andropogon gayanus* and *Hyparrhenia pseudocymbaria*, with some *Balanites aegyptiaca* and *Ziziphus spinachristi*.

More open woodland savanna of the main sand sea

Acacia senegal, with *Combretum cordofanum*, *Guiera senegalensis*, *Lannea humilis* and some *Boscia senegalensis*, *Balanites aegyptiaca* and *Commiphora africana*, in open stand, to average height of 6–7 m. and maximum of 10 m. Limited shrub growth; well-developed short to medium grass and herb mantle, composed of *Aristida*, *Cenchrus* and *Eragrostis* spp., with *Blepharis linariifolia*.

Formation of the Archaean plateau, transitional from woodland to thorn savanna

Albizzia/*Acacia* woodland savanna of the Wadi Debarei and adjacent Wadi 'Azum basin: *Albizzia sericocephala*, with *Acacia sieberiana* and *Acacia campylacantha*.

More open woodland savanna of the Wadi Barei basin: *Acacia senegal* and *A. mellifera* as dominant trees, with some *Anogeissus schimperi*. *Combretum hartmannianum* and *Terminalia brownii*.

Open thorn savanna of the northern and eastern margins of the Archaean plateau

Thicker *Acacia* thorn savanna of the El Geneina-Kebkebia zone and south of the Jebel Marra: *Acacia senegal*, *A. mellifera*, *A. seyal*, *A. nubica*, *Albizzia sericocephala*, generally with open canopy, but some thickets; tops to 5–10 m. Shrub layer. Grasses include *Aristida* spp., *Eragrostis* spp. and *Cenchrus biflorus*.

Open thorn savanna of upper Wadi Kaja basin and the plateau eastwards of the Jebel Marra: *Acacia mellifera*, *Commiphora africana*, *Acacia nubica*, *Acacia tortilis*, *Acacia senegal* and *Boscia senegalensis*, 5–8 m. high with open canopy and some shrubs. Variable grass growth; *Aristida* spp. most abundant.

Open thorn savanna of southern Wadi el Ku' basin, extending on to the western margin of the sand sea: *Acacia senegal*, *Guiera senegalensis*, *Balanites aegyptiaca* and *Boscia senegalensis* growing to about 5 m., with some shrubs. Dense short grasses and herbs, including *Aristida* spp., *Chloris* spp., *Chloris biflorus*, *Eragrostis tremula*, *Schoenfeldia gracilis* and *Boscia linariifolia*.

Open thorn savanna of the zone east and west of Kutum: *Acacia mellifera*, *Commiphora africana* and *Boscia senegalensis*, growing to 3–7 m.; no shrub layer; with *Aristida* spp., *Eragrostis* spp. and *Chloris biflorus*.

Open thorn savanna of the Karnoi-Ermil zone: *Boscia senegalensis*, *Acacia mellifera*, *A. nubica*, *A. tortilis* and *Maerua crassifolia*, growing sparsely to 3–7 m., with thin, variable short grasses, mainly *Aristida* spp.

Riparian thorn formation of the Wadi el Ku' and main tributaries: *Acacia mellifera* dominant, with *Boscia senegalensis*, *Acacia nubica* and *Balanites aegyptica*, often in a dense growth of bushes and forming a canopy, average height 3 m., but may attain 10 m. *Hyphaene thebaica* locally in south. Shrubs include *Cadaba farinosa*, *Capparis tomentosa* and *Grewia tenax*. Variable grass growth, thinning in thickets, which includes *Aristida* spp., *Echinochloa colona*, *Eragrostis gangetica* and *Chloris biflorus*.

Semi-desert scrub, north of the line through Furawiya Wells and Musbat:

Scattered, stunted bushes, mainly *Maerua crassifolia*, growing to average height 2 m. Abundant *Chloris biflorus*, with *Aristida plumosa* and *Panicum turgidum*.

On the accompanying map, indeterminate limits are shown by pecked lines. The annual isohyets (in mm.) are based upon data obtained in the period 1920–59 at 22 stations. Of these, five had been recording for 7–10 years, thirteen for 11–20 years and four for more than twenty years.

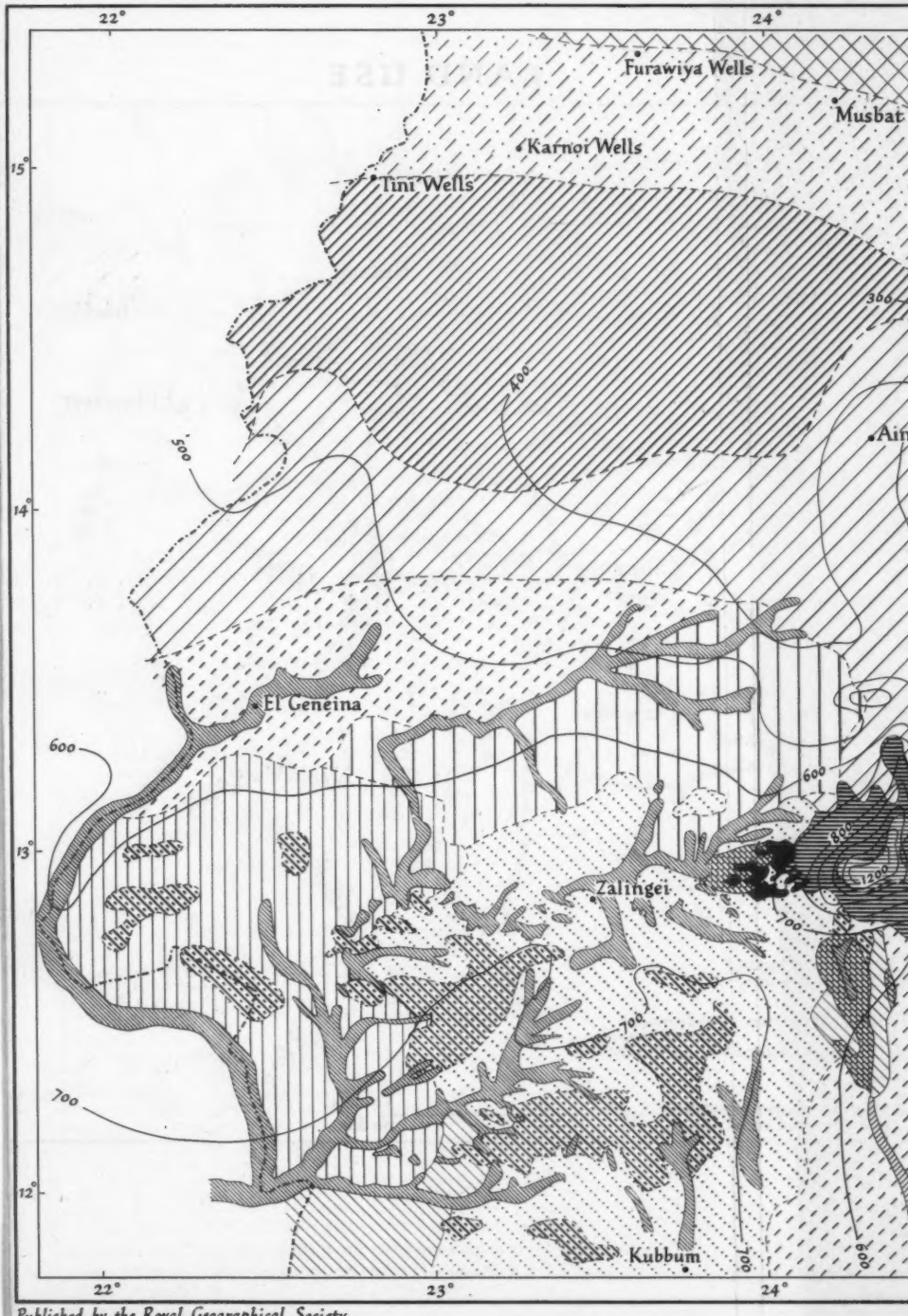

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Fig. 1

VEGETATION TYPES OF CENTRAL DARFUR

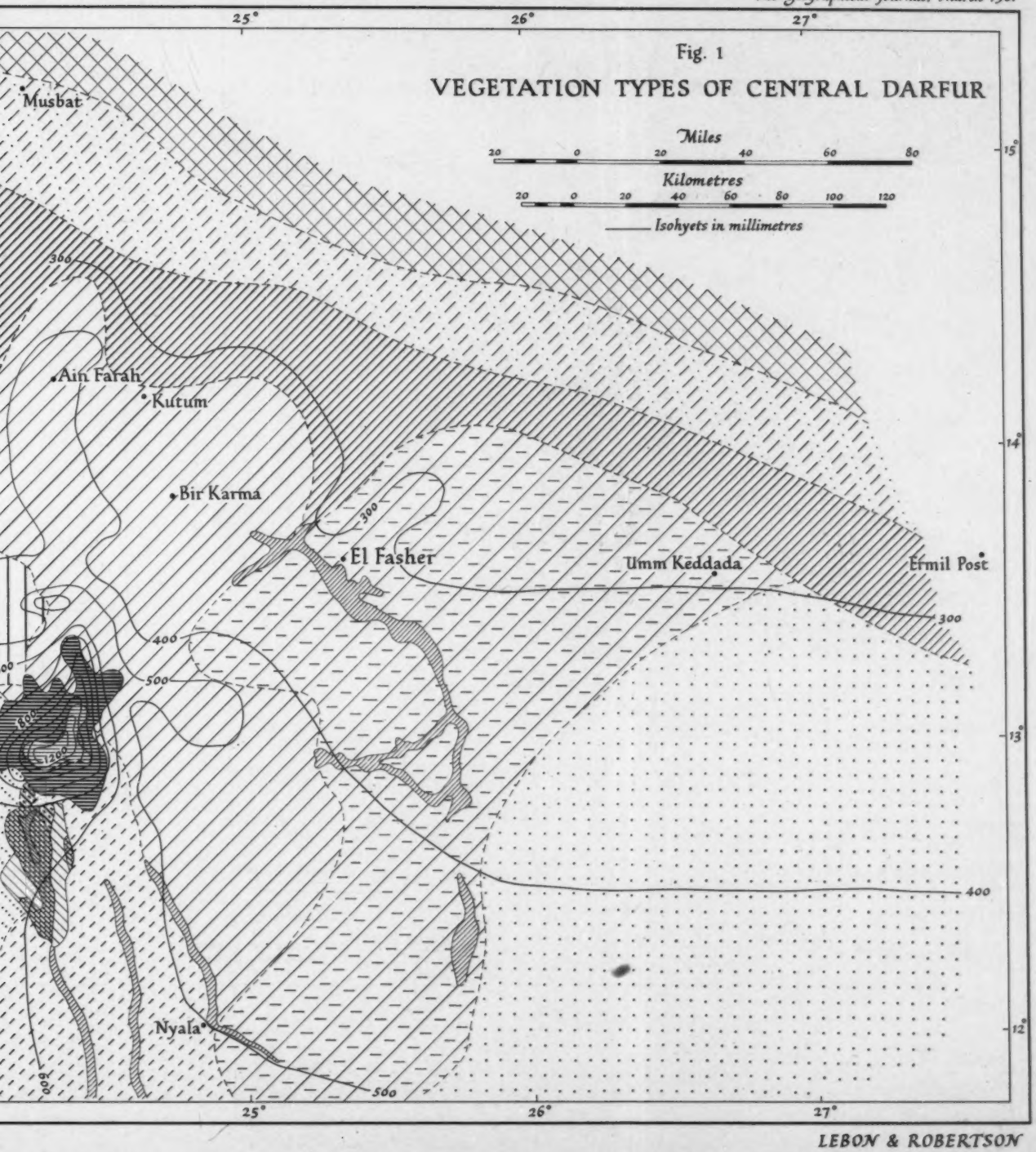

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Fig. 2

GEOLOGY

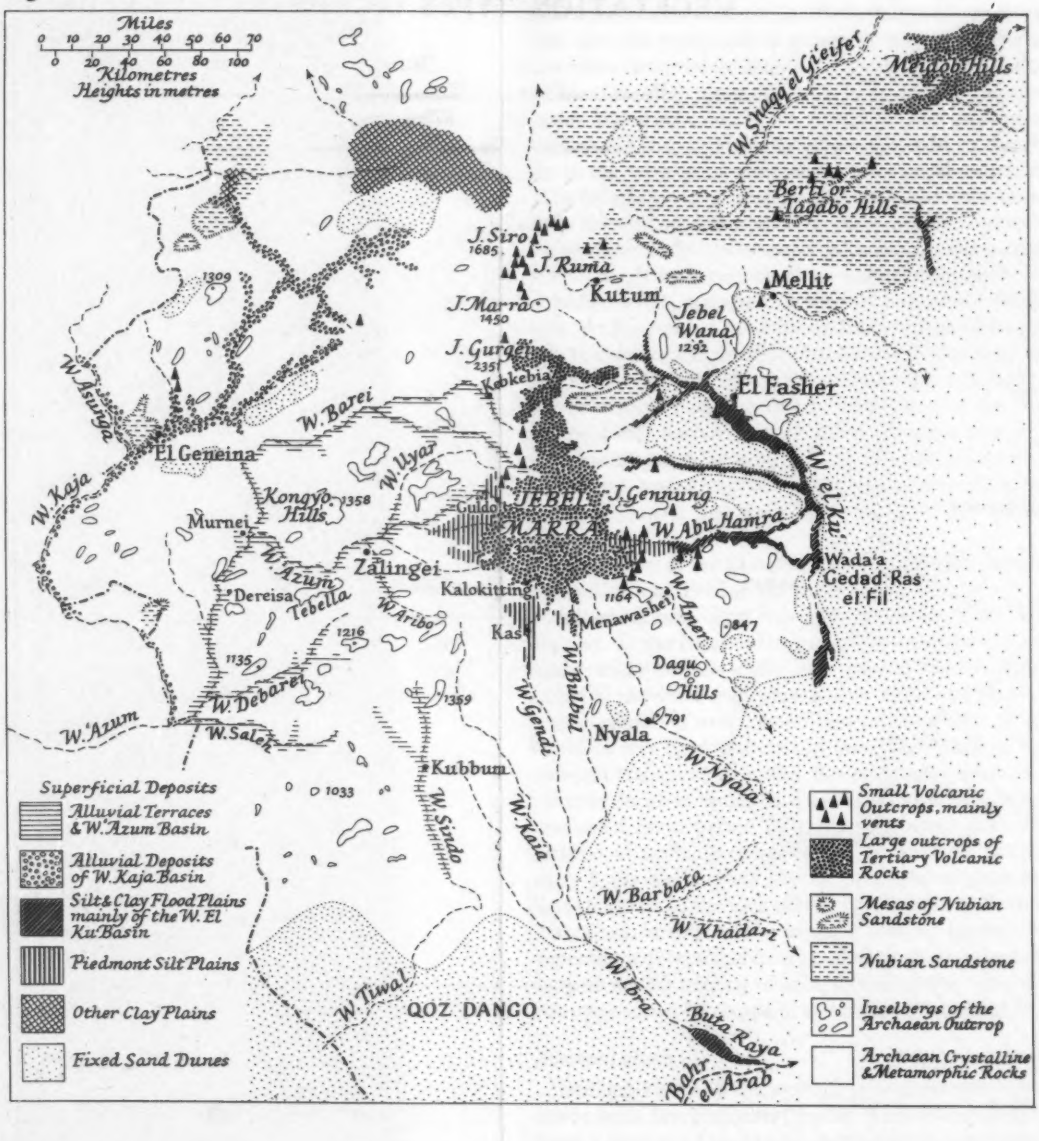
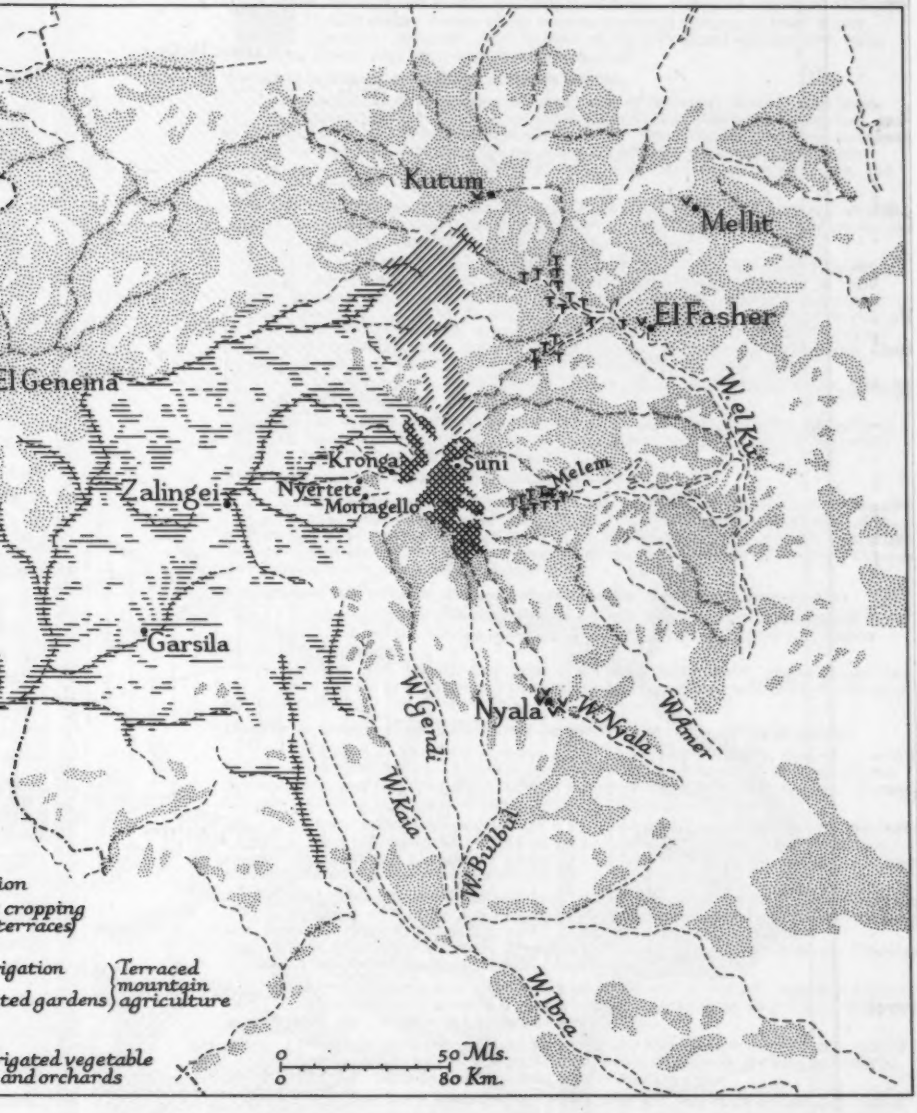


Fig. 3

LAND USE


Kutum
Mellit
El Fasher
El Geneina
W. el Ku
Kronga
Suni
Melem
Zalingei
Nyertete
Mortagello
Garsila
W. Gendi
Nyala
W. Nyala
W. Amer
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ion
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Terraced mountain agriculture
igated vegetable
and orchards
0 50 Mls.
0 80 Km.

metres disappeared. Allowing for evaporation, most of this loss must recharge the groundwater reservoir in valley sediments to maintain during the ensuing dry season the mainly subsurface flow which probably continues throughout the year. This groundwater, moving slowly downstream, is forced to the surface just above constricted sections. Perhaps the most notable example of this is in the Dereisa gorge. The existence of shallow, and possibly very extensive, groundwater reserves in the valley sediments is important. At present the inhabitants rely on this water for themselves and their livestock in the dry season, and also use it to a very limited extent for irrigation. But there are considerable possibilities for its conservation and exploitation by use of subsurface dams in constricted sections in Wadi 'Azum and by pumping from wells on to nearby irrigable lands.

The run-off from the southern, eastern and northern slopes of the Jebel Marra range is discharged into two principal river systems. From the southern slope the Wadi Bulbul and the Wadi Gendi flow southwards, and on reaching the plateau are joined from the west by the Wadi Kaia and the Wadi Ibra. Uniting to form a single river just north of the 11th parallel (perhaps because of the obstruction offered by the sand zone), their waters then cross the dunes to the Buta Raya, a depression communicating with the Bahr el 'Arab, and flooded during the rainy season. The headwaters of the other and larger system, that of the Wadi el Ku' (called also the Wadi Golo near El Fasher), converge to the neighbourhood of Kutum, and the main trunk then flows generally southwards (or south-south-eastwards) past El Fasher and Wada'a to about the 12th parallel. Although the Wadi el Ku' and its main tributaries near the uplands flow in coarse sandy beds, like those of the Wadi 'Azum system, at distances of from 10 to 20 miles from the foothills, their channels broaden and become silt plains from 2 to 8 miles wide, which are flooded at the height of the rainy season. It is within such an expanded silty plain that the waters of the system eventually cease to flow near lat. 12° N. But at one point along the main channel, Gedad Ras el Fil, the river cuts through Archaean rocks in a shallow gorge. No gauging has yet been undertaken within the Wadi el Ku' (Wadi Golo system). The region drained by this system (as will be shown later) suffers greatly from water shortage during the latter part of the dry season, and in the future control works will be required to impound not only domestic water but also, doubtless, water to irrigate portions of the silt flood-plain designated for novel and improved forms of cropping. Recording of necessary hydrological data should begin now.

Evidently the rivers of the western plateau contrast markedly with those of the east. The former exhibit a normal dendritic pattern, and normal features of longitudinal profile and fringing terraces. The latter correspond only near their sources, and during their traverses of the Archaean plateau. Where they reach the dunes they become enfeebled. The yielding sand is undercut during floods, and the flood-plains have thereby become widened. Concomitantly, the water shallows and its velocity is checked, allowing silt to be deposited. Thus, the broad, silty flood-plains already described have come into existence. Loss of volume is caused both by percolation (especially at the margins), evaporation and transpiration (from fairly thick woodland, amounting in places almost to gallery forests). After attaining a maximum discharge, probably near El Fasher, the volume diminishes southwards (it may be inferred) until eventually flow ceases and water vanishes in the unequal contest with evaporation and deep sand. It is also apparent, from the map and from observation in the field, that the present southward course of the main Wadi el Ku' is the outcome of the resistance to eastward flow offered by the main mass of the sand sea. The drainage is deflected southward. It is probable that beneath the sand

are ancient eastward-declining valleys, communicating either with the Wadi el Milh or the Bahr el Arab at about 27° E. At many places along the east bank of the Wadi el Ku' the dunes rise in a bluff to a height of about 100 feet above the flood plain, and there can be little doubt that this slope has arisen from the impact of the river trying to swing eastwards against the sand. No tributaries reach the Wadi el Ku' from the east below El Fasher. There is, in fact, no surface drainage on the dunes of eastern Darfur, for all rainfall is immediately absorbed.

Vegetation and Soils

Jebel Marra and the western plateau

The dominant vegetation of the western plateau is savanna woodland. In places, along streams on the western flank of the mountain, woodland thickens almost to gallery forest. In contrast to the wooded plateau, the highest zone of Jebel Marra itself is almost treeless.

Jebel Marra.—Much of the soil on the upper slopes (above 2000 metres) of the mountain itself is very thin, or consists largely of unweathered pumiceous tuff. Its water-retaining capacity is low, and the zone is primarily open grassland and associated small herbs. Trees normally only occur in favoured sites, by streams or in sheltered spots where more soil has developed (or remained). Heather and lavender are common on tuff slopes, and a number of possibly relict species found also in the British Isles occur. Bracken is common both within the crater and on the high lava plateau north-east of it. The typical tree of Jebel Marra is a graceful wild olive, *Olea laperrini*. It is common in the main crater, especially around the smaller of the Deriba Lakes, but occurs widely over the mountain as scattered individuals or groups. In the zone just below 2000 metres there is much cultivation, including terraced irrigation. Deep soils developed from basalt lavas are retained in this way.

The piedmont zone.—Deposits of water-transported material occur at the foot of Jebel Marra, and are often deep. Natural exposures over 20 metres high along the sides of streams have been seen. These occur west of the Nyertete lava lobe, together with smaller areas west of Guldo and again in the Kalokitting–Kas area immediately south of Jebel Marra. Similar exposures are visible at Keila and Melemm to the east. Soils developed thereon are dominantly sandy clays or loams and may be rather stony, though large stones normally are not common above 1 metre. They are generally very slightly acid, of good structure and quite high fertility status. Where they are not cultivated, vegetation consists of tall grassland with scattered trees.

The valleys of the western wadis.—These contain recent alluvial soils on the flood-plain and lower terraces, and on upper terraces rather older soils of similar origin. Some of the latter may contain material of volcanic origin, notably water-worn pumice fragments. Textures are very variable and the coarsest-textured soils usually occur on the flood-plain. Quite fine-textured clays may occur on the lower terraces. The older upper terrace soils are predominantly sandy clays and loams and show some evidence of downward eluviation of fine materials. They become extremely hard when dry. Most of the lower terrace soils are cultivated. The typical vegetation consists of woodland dominated by *haraz* (*Acacia albida*), crops being grown beneath the trees. On the flood-plain where water-tables are near the surface, tall reed grasses are common.

In the valleys of the eastern rivers small areas possessing the characteristics of the lower terraces of the Wadi 'Azum system have been identified along the Wadi Golo

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A seasonal river, the Wadi 'Azum, passing through a gorge in Archaean rocks near Dereisa. The constriction forces water to the surface, even in the dry season

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The Jebel Marra massif from the east; from the perennial stream below Suni

The Jebel Marra, seen from the west near Kronga, showing part of outer wall of Deriba crater
Hunting Technical Services, Ltd.

both above and below El Fasher, and also its principal tributaries, within and to the east of the foothills. They have not been studied or mapped in detail like those of the west occurring within the area of the Jebel Marra investigation, but inspection in the field shows that soils are commonly medium or light loams.

The plateaus and rocky hills of the west.—With one exception, described below, this type of terrain is accompanied by shallow, generally sedentary soils derived from the Basement Complex rocks, and predominantly coarse-textured. In more rolling country, fragmentary catenary sequences have been observed. Locally, especially on the northern side of the Wadi Debarei basin, are quite deep drift deposits of material derived from the Basement Complex. The associated vegetation is dominantly a short or medium grass savanna, the dominant trees being *Albizzia sericocephala* (associated with several *Acacia* spp.) in the north and north-east and *Anogeissus schimperi* in the south and central-west. The distribution reflects, at least in part, rainfall distribution, *Albizzia* savanna occupying the drier areas. *Anogeissus* woodland is the dominant vegetation of the western plateau. Along drainage lines in this zone groups of mahogany are widespread. Over the small outcrop of Nubian Sandstone near Garsila typical reddish sandy soils have developed. These soils are much cultivated, growing millet and groundnuts.

Relatively small areas in the north-east, and increasingly large areas in the south-west, are occupied by dark grey "cracking" clays analogous to those of Kordofan and the Gezira. These bear a characteristic vegetation consisting of the red-barked *Acacia seyal* and grasses. Where rocky hills rise above the general level of the undulating plain, the woodland usually changes quite abruptly, though in some places where slopes are gradual a wide transitional zone occurs. Hill woodland is dominated by the paper-bark tree (*Boswellia papyrifera*) throughout the bulk of the area; but in the north and east quite an abrupt change occurs (roughly north of Guldo and east of Kalokitting), *Boswellia* being replaced by the related species *Commiphora africana*.

The eastern plateau

Little work has been done on the soils of the plateau east of the Jebel Marra range, but three main classes exist: (1) of the dunes, which are friable, coarse, porous and doubtless immature because of the lack of cohesion as well as of limited pedogenic activity; (2) of the flood-plains along the lower Wadi el Ku' and its chief tributaries, which are grey cracking clays; and (3) of the Archaean plateau, which are comparable in their variability of texture, depth and pedological properties with those of the western plateau already described. In the area occupied by the third class, rising ground, and especially watersheds, appear to have very shallow soils, and the surface is often very stony. But there are many areas of rather deeper reddish soils, which can be cultivated, but which become very hard during the dry season. Some of these soils may be colluvial; others, especially to the south, where the present rainfall is greater, may contain some sand of aeolian origin, for it is unlikely that this area, adjoining the deep sand sea, did not receive a deposit of sand during the arid period when the *erg* came into existence. Small outliers of *qoz* still survive west of the main area.

There are correlative contrasts in natural vegetation. The savanna of the sand dunes is notably more sparse than that of the flood-plains, where thicket flourishes in the moister areas. Growth on the Archaean plateau is intermediate in character. Exceptions to these generalizations may also be observed, e.g. in the Wadi Golo flood-plain, about 25 miles south-east of El Fasher, there is an absolutely level plain of grey cracking clay, quite treeless, and bearing only short grass and herbs. A gradual transition to denser growth and greater height is to be observed

west near Kwong, showing ... of outer wall of Deriba crater
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southwards. Near Nyala the scattered broad-leaved trees and the *dom* palm of the river bed introduce a new element into the savanna.

Local Studies of Agriculture and Land Use

The western valleys

The lowlands.—The present husbandry in the western valley is of considerable interest; it is a remarkably integrated and conservative system serving the needs of both the sedentary population and, in the dry season, immigrant nomadic peoples. The sedentary population is distributed along the valleys where water is available throughout the year. Most crops are grown during the summer (rainy) season, on the alluvial soils of the river terraces. The predominant crop is sorghum, which is utilized by the local people in several ways, including production of a "beer" which forms an important part of their diet.

Most cultivation is on the "lower terraces", on alluvial soils under the characteristic *haraz* trees. These, unlike most trees in Western Darfur, shed leaves at the onset of the rains, and are green throughout the dry season. During the rains the alluvial soils under the leafless *haraz* trees are cropped with sorghum, millet and other crops. The *haraz* trees are in new leaf in October, when the crops are mature, and harvesting continues through November—now in the shade of the trees. At about this time cattle belonging to the Baggara Arabs (notably those belonging to the Beni Helba tribe) move south into West Darfur and, together with local cattle, graze the crop residues under the trees. Later, the *haraz* pods fall off, providing additional animal feed. Thus a very interesting and basically sound system of mixed farming has been developed, with animal manure, leaf fall and crop residues all contributing to maintenance of soil fertility. Limited analyses have revealed quite a high content of organic matter, nitrogen and phosphate in some of these soils, data which are confirmed by the excellent crops grown. Any extension of irrigation on to these lands eliminating the present winter grazing, will need perspicacious planning to preserve fertility. A source of potential danger to the present system is destruction of the *haraz* trees, which play such an important part in the cycle. Uncontrolled grass fires, which severely damage these winter-green trees, circumvention of the present forest laws for their protection, and ill-considered arguments condemning the *haraz* trees because they are thought to harbour birds inimical to crops, all threaten the continued existence of these beautiful and agriculturally valuable trees. Very little regeneration is to be observed in the main valleys of the western wadis.

The flood-plain is comparatively little cultivated. The soils are often very coarse and the water-table is often very near the surface even in the dry season; and, particularly in the lower reaches of Wadi 'Azum, severe flooding occurs during the rainy season. Small areas of groundnuts, sorghum and millet are grown in the wet season. Rice may be found in clay depressions, sown towards the end of the wet season and harvested in dry weather, about the end of the year. During the dry season sweet potatoes also reach maturity, and nicotine tobacco (for chewing) is grown in small plots usually beneath *haraz* trees. This crop is virtually the only important cash crop in the lower western wadis. It is not irrigated, but is grown where the water-table is less than two metres below the surface, so that normal soil moisture is available to the plants. Very limited irrigation, the water usually being drawn by hand from shallow wells, is practised on the flood-plain in the dry season. The much-liked onion is by this means grown on tiny, carefully tended plots—each plot about 3 feet square. In one or two places, near larger centres of population, enterprising local farmers grow larger areas of onions using the *shaduf*, a simple

system involving a weighted beam which, though still operated by hand, allows water to be drawn much more quickly. The upper terrace is used mainly as grazing land and as sites for villages. At this height there is no danger of flood, and sites well above the wadi bed suffer less from the night frosts of mid-winter. To live away from such places is advantageous to people who make little use of clothing and bedding.

Fruit growing.—Fruit growing has increased throughout the area since the establishment of Government orchards in Zalingei. Fruit growing requires irrigation, so that small orchards are located along the perennial streams on the western flanks of the Jebel Marra, and at scattered sites on the flood-plain and lower terraces of the western wadis, where water is drawn from shallow wells. Many varieties of fruits are grown including citrus fruits; guavas, mangoes, pawpaws, bananas and mulberries are also grown. Most irrigated orchards have plots of sweet red sorghum, used as sugar-cane.

Terracing on the western plateau.—Terracing on the high Jebel Marra will be described in a later section. During the dry season 1957/58, however, low-level helicopter flights revealed extensive terracing throughout the area between Jebel Marra and the western frontier after grass fires. Earlier, these old terraces were invisible. All these terraces are unused today. Although Barbour (1950) had recorded rudimentary terraces on hills north of Dereisa, their full extent has not been previously observed.

The origin and age of these terraces is an interesting question. Their presence over such huge areas—for they appear to cover all ground which is not quite flat—perhaps indicate that a much greater population existed formerly, which may have been living under rather different climatic conditions (though it must be remembered that in the Jebel Marra today only a small proportion of terraced land is cultivated, the rest being in fallow).

Livestock.—The most important livestock in West Darfur are cattle. There are extensive natural grazings—the predominant sparse woodland, without a canopy, allows a dense grass to grow. These natural grazings are utilized to very varying extent, according to the availability of water supplies. Their better use could be developed in conjunction with irrigation projects. The cattle population is both resident and nomadic. The nomadic cattle herds enter the area in large numbers soon after the rains cease and are at full strength in November. These cattle are generally very variable as to breed and condition, but some tribes own cattle which are relatively uniform. Beni Helba cattle, for example, are generally white, grey or black and white; they are good milkers and are well-fleshed.

The piedmont lands.—In the west, away from the wadis, cultivation is confined to the piedmont soils to the west and south of Jebel Marra itself, and to the tiny sandy area near Garsila described earlier. Of the main areas of piedmont soils, those near Guldo and Kalokitting are largely cultivated, but the largest area stretching westwards from a base roughly at Nyertete is cultivated hardly at all. Some of this area is remote from water supplies, but this does not seem to account for lack of cultivation nearer to water sources. A farm at Nyertete, operated by prison labour, produces excellent crops from these soils and fine citrus fruit is grown there also. Where the piedmont soils are cultivated the predominant crop is bullrush millet. The system of cultivation in such cases consists essentially of continuous cropping with millet. The most intensive use of these lands is around Kalokitting, but limited topsoil analyses conducted on samples obtained in 1958 indicated that the soils being thus intensively cropped may be deteriorating. There is little cultivation on the Melemm–Keila piedmont plain, apart from small plots, often enclosed in a thorn

fence, in which millet is grown, and the use of selected places for tobacco-growing by methods which will be more fully described later. The area is, however, much grazed by the cattle of local inhabitants as well as by those of people migrating from the east when water-supplies fail in the middle of the dry season.

The Jebel Marra

Apart from areas of ash and tuff, the Jebel Marra and its northward extension to the Jebel Gurgei are utilized for mixed husbandry. The most remarkable characteristic, observed and commented upon by many travellers, is the existence of terraces on most slopes of lava flows, save only the most precipitous, and attaining to heights certainly exceeding 9000 feet. In great part these terraces appear to be unused and neglected, if not abandoned; but, although some recession of the mountain population is taking place from the highest and remotest parts of the Jebel Marra and from parts of the Jebel Gurgei, many of the apparently abandoned terraces are simply being fallowed, and after 10 or 15 years will be repaired and cultivated again. The length of the cultivation cycle varies, and nearer the homesteads is probably shorter than elsewhere. The basic grain is bullrush millet (*dukhn*), grown during the rainy season when cattle and goats graze on fallow terraces and the uncultivated, largely treeless, slopes. Some wheat is grown also above 2000 metres. After harvest, cattle are often confined within thorn fences on selected areas near the homesteads, where the cultivation period may therefore be prolonged.

In the Jebel Marra proper (the higher and southern portion of the range) the population is completely sedentary. The rain-grown crops are supplemented by those planted in small irrigated gardens along the perennial streams and near springs. On the east side, in the valley of the Wadi Leibi, the construction, in 1937, of a road usable by lorries in the dry season as far as Suni (alt. 1900 metres) was followed by a much more considerable advance of citrus fruit cultivation, both at Suni and at Jawa, some miles down the valley. In both localities gentler slopes permit almost complete terracing close to a large perennial east-flowing stream. At Suni, in a natural amphitheatre at the foot of the precipitous eastern flank of the main watershed, the area thus terraced and irrigated measures one and a half miles along the river, and has a breadth of between a half and threequarters of a mile. At Jawa the area used for citrus fruit orchards is more elongated and discontinuous. Small holdings are the rule. The number of trees owned by each farmer does not usually exceed forty. The standard of husbandry and production is good, and is especially aided by manuring. Cattle owned by the fruit-growers are pastured on the mountain slopes and kept within enclosures at night. Manure is carried down to the orchards in leather saddle bags. Some growers are now buying young cattle from the plateau to increase their herds and hence their supply of manure. Thus, citrus fruit production on the eastern side of the high Jebel Marra is more advanced and commercialized than to the west, and this may be attributed to limitation of land that is irrigable and accessible by road and the proximity of two urban markets at El Fasher (population, 1955, 26,000) and Nyala (8000).

Farther to the north, especially in the Jebel Gurgei area, irrigated gardens cannot be established for lack of perennial streams. Domestic water is generally obtained from wells sunk into the detritus or decayed rock at the foot of slopes or, less commonly, from springs. These sources become unreliable towards the end of the dry season, and part of the population migrates, with cattle, to more dependable sources, e.g. at Sereif to the west. Thus the economy is semi-nomadic, and resembles that of areas in east-central Darfur, about to be described, in which water shortage, again, hinders sedentariness.

Agriculture to the north-west, north and east of the Jebel Marra range

Cultivation is extensive in this large area, but is discontinuous because of unsuitability of soil, lack of water, or both. Most cultivated land is on dune, but large areas, which will be noted later, are on deeper soils of the Archaean plateau, and piedmont soils close to volcanic plugs or lava flows appear to be much valued. The principal crop is again bulrush millet (Ar. *dukhn*), grown (towards the south) in conjunction with sesame and groundnuts, in alternation with fallow of variable length. In many places the fallow is deliberately lengthened to 12–15 years, so that the regenerating gum arabic tree (*Acacia senegal*) may yield its produce during the last third of the cycle.

In the west, water is available in the beds of the main branches of the Wadi Kaja, and at the foot of the small uplands north of el Geneina, but few of these sources (mainly in the beds of the main trunks) last until the end of the dry season. From January onwards most of the inhabitants must move southwards with their camels, donkeys and cattle to the Wadi 'Azum basin. It may be remarked that, whereas in the Wadi Barei and Wadi 'Azum basins cultivation is confined almost wholly to valley terraces, and the Archaean plateau is generally avoided, in the Wadi Kaja basin the tilled lands extend more widely. The northern limit of considerable cultivation is latitude 14° 45′. Farther northwards, rainfall is still sufficient for *dukhn* in most years, but absence of water sources prevents grain-growing except near permanent wells, such as Karnoi and Tini. This area is, however, suitable for camel-rearing, but herds are reduced in the dry season by migration northward to the *gizu* grazing along the Wadi Howar and southwards to the Wadi 'Azum.

The northern extremity of the Jebel Marra range and the area around Kutum are much-tilled and populous. The people are essentially sedentary, thanks to good wells in the main valley, and at the foot of numerous volcanic plugs and lava flows in the Jebel Ruma–Jebel Siro uplands, west of Kutum, again providing evidence of the water-holding properties of basalt in Darfur. Again, the clearance of trees and the frequent cropping in small piedmont areas close to volcanic uplands is remarkable, and it is clear that the combination of soils rich in potash, calcium and magnesium and good water supplies makes such places especially attractive to native cultivators.

East of Kutum, and southwards past El Fasher to Nyala and beyond, cultivation is mainly upon dune. The larger dune areas are shown on the land-form map, but there are also smaller areas among the rugged hills of the Archaean plateau or the Nubian sandstone north and east of El Fasher. The main cultivated areas are:

(*a*) Among the eastern foothills of the Jebel Marra range and along the valleys of affluents of the Wadi Golo–Wadi el Ku' system between Kutum and Menawashei, in which are many good permanent wells.

(*b*) From El Fasher north-eastwards through Mellit to the eastern end of the Tagabo hills, where the tilled land is almost exclusively dune.

(*c*) Southwards from El Fasher along the west bank of the Wadi el Ku' and, on a much smaller scale, along the east bank. On the Archaean plateau north and west of Nyala, tillage is reduced to well-separated small areas close to permanent wells on the Wadi Nyala, the Wadi Amer and their tributaries.

Thanks to the good permanent water sources in the first of these areas, the population is mainly sedentary. In the other two, however, water is scarce during the dry season and the population is semi-nomadic. In the north fewer cattle are kept, and more camels. The superior mobility of the latter enable pastures distant from the permanent wells to be grazed, and accordingly long-distance migration takes place, both to the *gizu* and southwards. From El Fasher southwards cattle form the chief

livestock belonging to the villagers. For several decades both human and bovine population has been growing, and the increasing demand for water, and the consequential shortage towards the end of the dry season have caused anxiety and have prompted remedial measures (by the Government) in the form of deep bores, surface reservoirs (especially at Mellit, Gedad Ras el Fil and near El Fasher) and works to improve the yield of existing well-fields in or adjacent to river beds. Because of geological conditions, few of these works have been wholly successful, but they have added to the water available during the early part of the dry season, and thereby deferred and ameliorated the annual crisis at the good perennial sources. Thus, there is still water shortage from January to June throughout the zone extending southwards from the Tagabo hills through El Fasher and along the lower course of the Wadi el Ku'. Consequently, part of the population and many cattle, migrate westwards to the eastern foothills of the Jebel Marra range, to the proximity of permanent wells. Some villages are almost deserted from January or February until June.

Two localized and specialized forms of agriculture remain to be described. The first is tobacco-growing, which is now on a scale sufficient for its product to be a leading export of the Province. The variety grown, Wad Amari, is said to have been introduced by a Koranic teacher named Hussein Wad Amari about 1820. It is grown on silty flood-plain terraces in the valleys of the Wadi Golo above El Fasher and its tributaries farther south, especially at Keila and Melemm. It is a dry-season crop, grown in small fields enclosed by thorn fences at selected sites where the soil, called *tertura* in Arabic, is a deep, even-textured loam. The seed is sown in October when rains cease and the soil begins to dry. Seedlings are planted out in November, when the surface is quite dry. Holes are therefore dug with the mattock to a depth of 6 inches, with the vertical face to the east. The individual plants are inserted in damp soil at the base of the vertical face where, during the subsequent wilt, shade will protect the tender plant from the intense radiation of the morning. Neither at the time of transplanting, nor afterwards during growth, is water applied. The plants attain maturity, and eventually stand 2–3 feet above the ground. It is not known if residual soil moisture during the entirely rainless growing period suffices, or whether the selected sites for cultivation benefit by water-tables above the limit of root penetration, i.e. about 2 metres. The tilled areas have evidently become localized by a process of trial and error. Harvesting of tobacco leaf begins early in December and continues to March. The leaf is withered and cured in booths of dried grass or millet stalks, and is conveyed in matting bags by camel or lorry to the government auction market at El Fasher. The tobacco is consumed wholly within Sudan, either as snuff or by chewing.

The second type of localized agriculture is confined to the immediate environs of Kutum, Mellit, El Fasher and Nyala. At El Fasher, before the annexation to the Condominium, gardens existed near wells, watered by the *shaduf* or from buckets drawn by native windlasses. Despite the great increase of population since 1920, the area cultivated has changed little, because of shortage both of water and available land. El Fasher remains a town in which fruit and vegetables are scarce and expensive. At Nyala a small garden of about 3 *feddans* was established on a terrace at the side of the river about 1925, to grow citrus fruit, mangoes and vegetables for officials. Other gardens were laid out by merchants of this progressing market town. The advent of the railway in 1959 has enabled diesel-engined pumps to be installed and operated. There is now a total of some 200 gardens and more than twenty pumps on both sides of the Wadi Nyala within about 5 miles of the town, growing a wide variety of vegetables between October and May, and also fruit.

Outlook and Problems

Among problems inviting further investigation (in addition to those already mentioned) is the genetic study of the watercourses and their attendant alluvial deposits. These could perhaps be related to the legacy of Pleistocene climatic fluctuations on the margin of the Sahara. In the east, research into the relief of the Archaean and Nubian sandstone surfaces buried by the sand sea may be feasible, now that geophysical equipment is being used in the search for new underground reservoirs, and accurate altitudes can be determined along lines of levelling from the railhead at Nyala.

Afforestation and the foundation of a hill station on Jebel Marra

Although almost the whole area, the high Jebel Marra alone excepted, is tree covered, commercial possibilities are small. Mahogany is widespread in the south-west, but nowhere in large stands. It can therefore only be exploited on a small scale and locally. Generally, existing woodlands are important only as fuel-wood reserves, which need to be established near larger towns. Major timber or other production from trees could only come from afforestation or plantations. There are suitable sites on the flood-plains of lowland rivers and on the piedmont soils near the mountain. In the latter situation irrigation may be needed during establishment. Perhaps the best area for afforestation is the moist western flank of the high Jebel Marra. A successful nursery and plantation already exists there, at Mortagello. But a much greater area, including the headwaters of most perennial streams, and beneath which may be important groundwater reserves, might be carefully protected and become a Forest Reserve.

Furthermore, the Jebel Marra is a unique and beautiful place. The middle slopes, 5-6000 feet, enjoy a delightful climate, especially during the dry season. They provide splendid sites for hill stations, which should perhaps be associated with experimental irrigated farms on perennial streams. Nyertete, which has amenities including a road, a good water supply, established orchards and beautiful scenery, suggests itself as first choice. On the east slope, Suni, which is rather more accessible from Nyala and El Fasher, possesses equal potentiality.

The irrigation potential

It does not seem likely that any very large schemes can be devised, but numerous interlocking small schemes almost certainly *can* appear, which would substantially raise productivity and improve the well-being of the people. Water seems likely to be the limiting factor, rather than land. The hydrology of the perennial streams, the movement of ground water in the bed sediments of the western and eastern rivers, and the nature and extent of deep groundwater in the lava rocks of Jebel Marra need further study. Only when this is done can the full potential for development be appraised. But already it is apparent that two main kinds of irrigation development are likely: first, from small surface reservoirs on the perennial mountain streams, perhaps linking several streams together; and secondly from subsurface dams in the lower reaches of the western rivers, and perhaps also in some of the eastern.

Such small-scale developments are in keeping with the requirements of the area. The rate at which schemes are instituted can vary; other essential preliminaries to actual development include a programme of crop experimentation on irrigated farms, at sites on the slopes of Jebel Marra and the plateau. Experimentation on dunes is already in progress in Kordofan.

Community development

In the introduction it was observed that Darfur is situated in the heart of Africa. Its distance from large markets and its tenuous communications have retarded its economic development. Its herders and peasant farmers are not far removed from a subsistence economy; but they do sell surplus grain, groundnuts, tobacco, gum arabic, camels, cattle, hides, chillies and dried tomatoes for money, to pay their taxes, and to purchase cloth, the services of tailors, shoes, simple utensils, tea, coffee, sugar, salt, etc. This kind of trade is active, not only in the few towns and larger villages with permanent markets, but to a much greater extent at the weekly or twice-weekly fairs or local markets which are held at chosen sites 10–15 miles apart in all areas with a village population. Since about 1932 the motor lorry has proved a powerful aid to marketing, and the completion of the railway to Nyala last year has already lowered the prices of imported goods and enabled merchants to offer higher prices for local produce.

There are no large mineral or power resources which might bring wealth quickly, and economic progress will depend upon increasing productivity by the peasant farmer. Whilst cash crops may be increasingly significant, it seems unlikely that Darfur will be able to follow the example of the Gezira and other schemes on the Nile, in which large capital investment and annual recurrent outlay for administrative supervision and specialized technical processes (such as pest control) are paid for by the sale of large volumes of a high-priced product. Advancement in the west rather demands a more diversified agriculture and an increase of the land cropped annually by each farmer, by the use of improved implements and perhaps some machinery. There is fortunately no lack of land in this province; if attention could also be given to growing fodder crops and improving pasture and pasture management, the rate of production increase might become more rapid than that of population. An earnest of the possibilities has been given by the mountain peasants at Suni who have so readily adopted commercial fruit growing since 1937. Improved communications and water supplies (including small irrigation works) are essential and so is community development, perhaps by adopting and adapting some of the methods which are proving so successful in other African territories and countries. No part of the province could fail to benefit from such measures, but perhaps the need for a beginning is greatest in the south-east, near the new railway terminus. But, before community development can begin, our present ignorance of social and economic conditions in Darfur needs to be mitigated. Thus, the conclusion is inescapable that in addition to the hydrological, pedological and agronomic investigations already outlined in this paper, social research is also required. If people are to be guided to avail themselves of new opportunities, their present mode of living must first be much more fully understood. Studies such as the present authors have undertaken are but introductory. The next step is to repeat, for selected areas in Darfur, the closer scrutiny of the lives of native cultivators undertaken ten years ago by M. De. Schlippe for the Azande in the province of Equatoria.

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The 'cauldron', or subsidiary crater, within the main Deriba crater; with the characteristic high altitude tree, Olea laperrini

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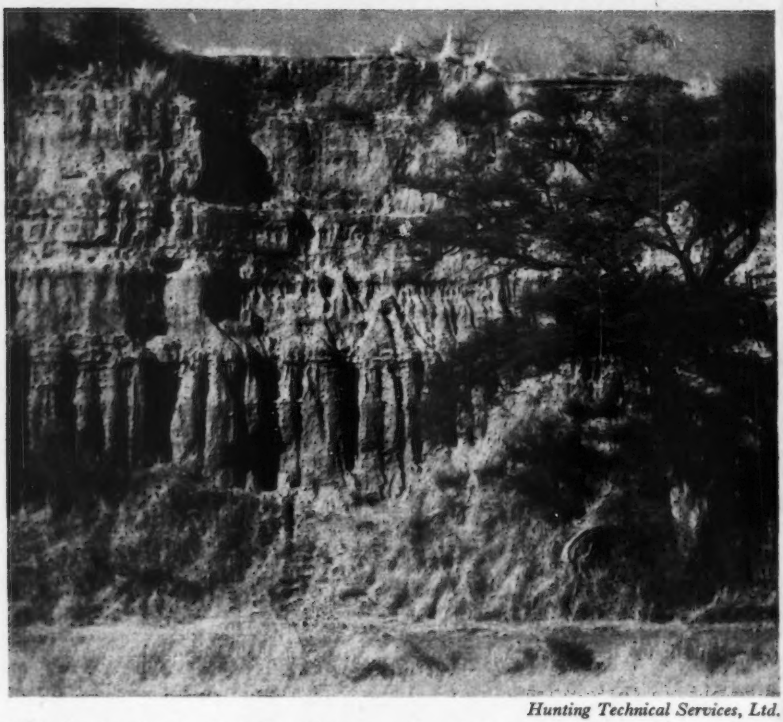

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"Piedmont alluvium" derived from erosion of the volcano, exposed in a wadi bed south-west of the Deriba crater; about 50 ft. thick

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Tobacco grown on alluvial soils, utilizing shallow groundwater in the dry season, under haraz *trees, near Zalingei*

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DISCUSSION

Afternoon Meeting, 23 May 1960

Before the meeting the CHAIRMAN (Professor J. A. STEERS) said: We are fortunate in having a joint lecture on Jebel Marra, Darfur, and its region. Our lecturers are Professor Lebon and Mr. V. C. Robertson. Professor Lebon knows much of the East very well; after leaving London he had experience as a professor in Ceylon and Baghdad before he went to Khartoum. Mr. Robertson, who is now with Hunting Technical Services, was a graduate of Edinburgh and then for some time with the Agricultural School in Cambridge. In addition, I should like to welcome the Vice-Chancellor of the University of Khartoum and the Cultural Attaché to the Sudan Embassy.

Professor Lebon and Mr. Robertson then read their paper

After the paper, SAYED BUSHRA ABDEL RAHMAN SOGHAYER, Cultural Attaché, opened the discussion by thanking the lecturers for their paper.

Mr. Michael BARBOUR (University College London): I first travelled in Darfur eleven years ago, and fully agree with Professor Lebon's conclusions, especially about the need for further social research. With reference to the terracing, not only terraces but also evidence of former village sites are to be found on many of the hills of south-west Darfur. But I see Dr. Arkell is here, so I need say no more about that. I think perhaps the hardships endured by the people of the region should be stressed. This is shown by the need for migration, not only by Arabs but also by Zaghawa and others, many of whom are compelled to migrate every year from further north to the streams of the Wadi 'Azum system. While naturally keen for development and commercial expansion, I feel it will first be necessary to take steps to alleviate the very considerable existing poverty and hardship among the local people.

Colonel Hugh Boustead and other District Commissioners in Western Darfur were formerly very keen on plantations of the gambil tree (*Cordia abyssinica*); this is not very large, but produces a most attractive timber, almost as good as Sudan mahogany. I should much like to hear if any of these plantations have proved successful. More important, I should very much like to see a map of the grazing potential comparable with the admirable map of cultivation potential that we were shown. Surely one of the most striking features of the maps shown us this evening was that in the south-west, alongside the comparative wealth of the great wadis with their flanking cultivations, the land between the streams was indicated as plain white. There is, I agree, no prospect of cultivation on these very thin soils, but it would be misleading to suggest that these admirable sources of water and belts of cultivated land are separated by bands of virtual desert. There is grazing for cattle there, and browse for camels, and I should like to know more of the potential carrying capacity of this land. Since the arrival of the railway at Nyala the further development of animal rearing in Darfur, by the control and improvement of these pastures, might be one of the best economic prospects of the region at large. Finally I agree that all parts of Darfur, and particularly Jebel Marra, are eminently worth visiting, long, tiring and dusty though the journey by land across the Kordofan *qoz* used to be.

SAYED NASR AL HAJ ALI (Vice-Chancellor, Khartoum University): I would say that, although many of the audience may have benefited from a technical point of view from this lecture, I too have benefited. I have often wondered why it is that Professor Lebon used to argue that geography was a difficult subject; now I realize that a geographer

must have everything! He must be a scientist, he must be a geologist, an economist, a sociologist—in a way, an agriculturalist; probably geography is a basic education for anyone who hopes to be of service to a country like Sudan. A training in geography opens the eyes of those who have to deal with the Sudan, both to the vastness of the problems and to its equally vast possibilities. We have listened today to a suggestion of at least one direction in which something might be done; when we tried to experiment in democracy in that part of Sudan an electioneering slogan was "Water and education", and the talk we have listened to today from Mr. Robertson and Professor Lebon illustrates both of these points. Water is at the bottom of everything, and education to perceive it is essential; rightly, the electors of Kordofan and Darfur were pressing for water and would only give their votes to those who would promise both water and education. I hope that the Sudan Government will be able to make use of this study as a forerunner to further research in this part of the country. It is typical of a really big part of Sudan, and may well represent one-third of the country.

The CHAIRMAN: Dr. Arkell is here, Reader in Egyptology at University College London, and formerly District Commissioner and Deputy Governor of this region.

Dr. W. J. ARKELL: I first went to Darfur nearly forty years ago, and I left it about twenty-five years ago. I have forgotten many details, but I have not lost my love for, or my interest in, Darfur. I was there as an administrator with an amateur love of archaeology, and I knew the north and the west best. I only toured Jebel Marra once or twice, and I was much struck by the extraordinary contrasts, which you get as you go round that mountain range, particularly on the western side, from one valley to another. You are reminded of Dartmoor in one place and of somewhere quite different ten miles further on in the next valley. With regard to archaeology, I did not have much time to give to it, because I was busy with other things, but I was struck by never finding one single palaeolith in the whole area and by only finding traces of the Neolithic far north of the area that we heard about today, along the Wadi Howar near the northern boundary of the province. We have certainly heard and seen in the pictures today evidence of climatic change. I don't know whether Professor Lebon or Mr. Robertson have any idea of the age of the *erg* as they call it—what I know as the *qoz* in eastern Darfur. I should be much interested to hear if they have; for I am certain that at the moment we are in a period of increasing dessication. The terraces in the hills to the north of Kutum, and around Ain Farah, are very strong and well-built and almost certainly Christian; if so, they are about a thousand years old. Rainfall must have been greater then, for with today's rainfall, crops would not produce an adequate return for the labour of building such massive terraces. The red brick ruins at Ain Farah have recently been proved to be connected with the Christian kingdoms of Nùbia—there was a monastery flourishing there about a thousand years ago. There are still a few excellent date palms in the wadis of Ain Farah and Ain Siro. They bear dates that approach the standard of the good dates of Dongola, from which they are no doubt descended.

After the Christian settlement, whatever existed in Darfur was almost certainly put an end to by the advance of Islam via Kano and Lake Chad. At the northern extremity of Jebel Marra in an area called Turra there are some massive stone ruins, some of which have been photographed and recently published, and some of which have never been studied at all. Of those that have been studied, some are almost certainly connected with Kanem, *c.* A.D. 1200–1300, but there is not now enough water there to supply a small village; clearly the northern end of Jebel Marra has dried up considerably of late. It is the same story with regard to the capitals of Darfur, of which El Fasher is the present capital, founded *c.* 1700. There is an old capital, or commercial centre, at Sueiny, some 40–50 miles north, and there are traces of old stone towns further north than that, in country that is practically waterless. Professor Lebon is right: improvements can only be made on a small scale, very different to the large-scale development in the Gezira.

The CHAIRMAN: Mr. Grove is Lecturer in Geography in Cambridge, and knows Nigeria and Lake Chad very well.

Mr. A. T. GROVE: I have not visited Jebel Marra, but it interests me because it is one of several volcanic plateaus, bordering the ancient drainage basin formed by the Chad basin and Benue valley. Climatically, it is intermediate between the Jos plateau and Tibesti. At some stages in the past, when the climate of the Jebel Marra may have resembled that of the Jos plateau at the present time, the western wadis drained through Lake Chad; at other stages, when sand dunes were being formed to the north and east, its climate might have resembled that of Tibesti at the present day. I wonder if any information was gained about the ages of terraces in the Jebel Marra, and also about the direction of the dunes in the surrounding area? I suspect that the linear dunes have been modelled by northerly or north-easterly winds, but I have noticed that in the vicinity of plateaus such as Tibesti, and of escarpments such as Bandiagara, one finds the dunes diverging round the uplands; the winds have been diverted either side of them. I wonder if any sign of this has been noticed in the vicinity of Jebel Marra.

The CHAIRMAN: Dr. Willimott, formerly at Cambridge, is now lecturing in Soil Science at Durham.

Dr. S. G. WILLIMOTT: I am not fortunate enough to have personal knowledge of this particular region but I would like to call attention to an area I surveyed to the east of the Nile, located near the Ethiopian frontier in Upper Nile Province, which bears some similarity to it. It extends roughly on a north–south axis over an area of 40 by 30 miles. Again it is a volcanic area, one of the few existing in the Sudan, with volcanic rocks and derived soils, and carrying a characteristic vegetation. Many of these soil-vegetation relationships, which Professor Lebon mentioned in his lecture, are very apparent in this region. It is known as the Boma plateau and it merges into the Lomareng plateau to the south, lying roughly 275 miles east of the Nile. Again it is remote and inaccessible, and very little known. As far as I can see there are great potentialities here, as in the Jebel Marra, for agricultural development. One point that impressed me greatly when I was there some few years ago was the striking fertility of the soils, especially as one moved from the lateritic peneplain on to the Boma plateau itself. The plateau is, of course, nothing like as high as the Jebel Marra; it averages about 3500 feet above sea level with Jebel Towat reaching 4000 feet. With its steep escarpment to the west it is a dominating feature of the landscape. But the marked fertility of the soils was everywhere apparent in the crops produced. Both annual and perennial crops were growing vigorously and appeared free from disease. Citrus was doing excellently as was the coffee (*Coffea arabica*), sugar-cane stood about 15 feet high, and all the fruits typical of that region appeared to be flourishing; only pineapple was absent. I well recall an old peasant digging up his cassava and it was quite amazing to see the size and number of the tubers he was getting out.

Another point that seemed to me of very great interest was the agricultural system practised by the Marille and Kechepo tribes. Apparently, because of the high fertility status of the soils, there is no need to practise shifting cultivation. These tribesmen are essentially agriculturalists, cultivating their crops year by year in the same locality and, so far as one could ascertain, the fallow running to about one year—a quite remarkable system. The presence of tsetse fly on the plateau, in contrast with its absence on the plain, may well explain the fact that the plateau peoples are cultivators while the Tapoutha on the plain are mainly pastoralists. In this region, as in many of the underdeveloped areas of the Sudan, the population was very sparse.

A further point of interest was the evidence of laterization and I was wondering whether similar formations were to be found on the Jebel Marra. On the top of the Boma plateau there is evidence of surface laterization of the rocks, which was more marked as one got down to the plain. Because of the importance of an understanding of the process of formation, as well as the distribution of laterite and the related soils, further investigation is necessary. The different stages of laterization observed on the Boma plateau may be the result of erosion at different altitudes over geological time.

In addition to the many aspects of development, which Professor Lebon and Mr. Robertson have indicated, there is great need for a pedological study of the soils of the Jebel Marra. The fact that the parent material of the derived soils is mainly of

volcanic debris is not sufficient, I think, to explain satisfactorily their marked potential for agriculture. The clay is of particular interest and one has the impression that minerals of the montmorillonite type are probably well represented in the soils of the Jebel Marra. But there remain other physical characters of the clay fraction which would certainly appear to merit closer investigation and might well prove to be of considerable practical significance in crop development on a diversified pattern. In any case, it is stimulating and satisfying to any of us who had the privilege of working in that vast and interesting country to hear of the development programmes now being carried into effect. And I would like to emphasize the Professor's conclusion that the policy of developing areas of promise, such as the Jebel Marra, is the right line to follow; and to suggest that the region of the Boma plateau, perhaps more remote and limited as it is, might well repay the cost and effort of its development.

Major ALEC HOLT: In the course of my years as Soil Conservation Adviser and subsequently as Adviser in the Land Use and Rural Water Development Department, I travelled extensively in all the provinces of the Sudan except the Northern. Among the areas which I had reason to study were those of Jebel Marra and Eastern and Southern Darfur, including the regions about which we have just been hearing. There is often an inclination, after listening to such a lecture, to feel that undue optimism may mislead an audience into thinking that great developments should be undertaken. Because of that feeling I would like to tell you that I do firmly believe that the economics of the Jebel Marra area should be fully investigated. My reasons for that conviction are that I have seen the most amazing results accrue from rural water developments in the Sudan, and I hope you will forgive me for presenting a few figures which may help you to understand that there are great opportunities for doing much good for the country's people, by no means the least being for those in the Jebel Marra and Darfur area.

In 1947 the Sudan Government began a new system of rainwater conservation in the rural districts in order that vast areas of good agricultural and pastoral land could be used throughout the year instead of only during the rains and a few subsequent weeks. This system had become practicable because heavy mobile machinery became available which enabled the construction of surface reservoirs for catching rainwater run-off in areas which had formerly been inaccessible and incapable of development. Mass human labour could not be employed on such works because of the lack of drinking water. In the course of a dozen years over 500 surface reservoirs have been provided in the Sudan and some 500 deep water bores where conservation was not feasible. I had cause in the latter part of 1958 to endeavour to assess the social and economic results of such work. I found that in the Nuba Mountains (where fifteen years ago there was but little agriculture) after four programmes of this water provision over 235,000 tons of rain-grown cotton had been ginned in the space of nine years and, in the three cropping seasons 1955–56–57–58, in Kordofan a total of 1,000,000 tons of durra and sesame had been harvested; all this in consequence of the provision of domestic water for the inhabitants and their cattle, sheep and goats. With such figures in mind you can well appreciate the advantages which may be forthcoming from the studies and development which Professor Lebon and Mr. Robertson have suggested.

Professor J. H. G. LEBON: First, I must thank the Cultural Attaché and the Vice-Chancellor of Khartoum University for their generous appreciation of our work in the westernmost province of their country. To expatriates working in the Sudan, such appreciation is greatly valued indeed.

Mr. Barbour asked whether a grazing map could be prepared as a counterpart to the map of land use which was shown. I think the answer is that, whereas the aerial photography which I mention does enable land use maps to be compiled in comparative detail, it is not so easy to use air photographs to prepare a grazing map showing the different grasses available, and the carrying capacity. It is necessary also to investigate the ground closely. I have been mapping land use in Darfur on the 1:1M. scale and the map shown on the screen has been based largely on those maps. I have found it

Terrace cultivation at 6000 feet on the west slopes of Jebel Marra, near Kronga. Only rain (summer) crops are grown as the water is saline here

Hunting Technical Services, Ltd.

Photograph: J. H. G. Lebon

Geilidat hafir, about 7 miles north of El Fasher, December 1956. Excavated in 1950, it normally contains water until March

Photograph: J. H. G. Lebon

Clay drinking trough at Bir Karma, about 40 miles west-north-west of El Fasher; November 1959

possible to locate by aerial photography certain areas which appear not to be used at all for grazing; and they will be so indicated when these maps are published. But that, I think, is about as far as one can go, when one relies mainly upon air photography as the basis of the mapping. There is, of course, a big difference between maps prepared mainly from air photographs and maps which are based upon detailed ground survey.

Dr. Arkell raised the very interesting and complicated question of climatic change. I think one should, perhaps, distinguish between any climatic fluctuations in progress at the present time, and those of the Pleistocene, which have undoubtedly left their legacy in the superficial deposits and in land sculpture; a detailed study of the latter in the field will be rewarding, but would require a specialist in this now rather well developed branch of geology. When commenting on the view that the province is now being desiccated, one must, I think, take account of the effect upon vegetation, of the increasing population and grazing during the last thirty or forty years. It is aggravating problems of water supply, and Major Holt would probably confirm that the initiation of new water supplies in Sudan leads usually not only to changes in grazing habits and cultivation, but to remarkable changes within a few years in the character of the vegetation. I am inclined to wonder whether observers have blamed climatic changes—for changes going on under our eyes—when the source of the change is really human activity.

Mr. Grove enquired about the alignment of the dunes of the former *erg*, or the *qoz*: I cannot say more than that in looking at large numbers of these air photographs, from the point of view of land-use mapping, I have noticed clear alignments extending over distances of perhaps 10–20 miles; but I am not really trained in this kind of air photograph interpretation.

Mr. V. C. ROBERTSON: First, Mr. Barbour's question about *Cordia* trees: *Cordia* is, of course, a tree producing a beautiful furniture wood. It has the unfortunate habit of branching; when the young tree starts the leader usually dies, and the next two side-shoots persist on, so that the tree is continually branching, and there is seldom a straight length of timber of more than about 6 feet. Many people have tried to induce it not to branch and pruned it in such a way that it grows straight. The last experiments I saw there were done at Wad Medani, but I do not think those concerned succeeded in altering the habits of the *gambil*; it is still being planted around Zalingei and the forest station on the western slope of Jebel Marra at Mortagello. There it is quite high—about 5000 feet. There is a big plantation out in the open and it is doing well. Down at Zalingei, I believe, many young plants fail. I think this is partly because nobody has studied the ecology of the *gambil* sufficiently; possibly it is a tree that likes to grow up in the shade and is too frequently planted in the sun. It suffers both from drought and from frost if planted in the open. I had long discussions with foresters about it when I was there. But its planting certainly is being carried on, though I do not think its habits are properly understood, at least in the lowlands.

The age of terraces? I cannot answer that. I saw all these many terraces, and was intrigued by them, but they were very old—not one of those I saw between Jebel Marra and the frontier was being cultivated, or looked as if it had been cultivated for a very long time.

Dr. Willimott's questions on the soils: I was leading an expedition which was looking into a number of things, including soils, in the Western Region, and we have much information which no doubt he could see, including many analyses. There is no evidence that I saw anywhere in western Darfur of laterization; I do not think it is wet enough. The only thing I did see, which was quite interesting, was on the eastern side. There was an exposure where a stream had eroded a tall bank, and there was what looked like an old lateritic soil buried beneath alluvium. With his views on the importance of pedological studies I agree entirely; and as to the question of clays, I have again got a certain amount of information, which might be made available to him.

The CHAIRMAN: There have been a good many discussions in this hall, but I have seldom heard such an interesting one as this afternoon and, I think, that is perhaps the best compliment our two speakers can have.

LAND USE AND SEDIMENT YIELD IN AN OLD PLANTATION TRACT OF THE SERRA DO MAR, BRAZIL

PETER HAGGETT

THE OLDER PART of the coffee belt of south-eastern Brazil provides a classic case of a land use cycle: from primary forest, through crop and pasture, to secondary forest. Coffee (*Coffea arabica* L.) was, at the beginning of the nineteenth century, confined to the coastal lowland around Rio de Janeiro, the Baixada Fluminense, but by 1850 it had crossed the Serra do Mar and had become well established in the foothills flanking the Paraíba river. Sergio Milliet (1939) has mapped the 20-mile wide swath of forest felling and burning through which the coffee frontier advanced for some 200 miles along the Paraíba to within a short distance of the city of São Paulo. Within another generation the coffee frontier had moved north-west to Campinas and Ribeirão Preto and with astonishing rapidity the plantation tract along the Paraíba collapsed: the coffee groves (*cafesals*) were abandoned to weeds and cattle, and the plantation houses (*casas grandes*) and slave quarters (*senzalas*) to decay and encroaching forest. This dramatic collapse of a social and economic system has caught the imagination of Brazilian novelists like Monteiro Lobato (1943), and such historians as Taunay (1939–45), Milliet (1939) and Simonsen (1940) have woven a web of theory and counter-theory over the complex causes of failure. Stein (1951, 1953, 1957) has summarized these views and brilliantly documented the rise and fall of the plantation for one Paraíba county, Vassouras.

Land use cycles have, however, less spectacular but no less interesting effects on the physical landscape. In a paper titled 'Land use and sediment yield' given at the 1956 Wenner-Gren symposium on *Man's role in changing the face of the earth*, Dr. L. P. Leopold indicated the linking of land use regimes with sedimentation cycles in the western part of the United States (Leopold, 1956). For the coffee cycle in the Serra do Mar foothills there is enough contemporary evidence to suggest that an investigation of this topic in a tropical area might reveal similar linkage. On crossing the Paraíba river near Entre Rios in June 1867, Richard Burton observed that:

> "Hereabouts the once luxuriant valley is cleaned out for coffee, and must be treated with cotton and the plough. The sluice-like rains following the annual fires have swept away the carboniferous humus from the cleared round hill tops into the narrow swampy bottoms, which are too cold for cultivation; every stream is a sewer of liquid manure, coursing to the Atlantic; and the superficial soil is that of a brickfield." (Burton, 1869, I, p. 112.)

Burton is one of a number of nineteenth century commentators who noted, like Cunha (1844, p. 31), this "sad aspect" of the *época de café* in south-east Brazil.

Test area: the Fortaleza basin

To investigate the relationship between land use and sediment yield in the old coffee belt it was necessary to select an area which contained both *cafesals* and timbered land. While this latter could hardly be virgin forest (*mata virgem*) it should not have been clear-felled or cultivated (see discussion below, pp. 52–53). It was further an advantage if the area was small, reasonably accessible and topo-

graphically surveyed on a large scale. The test area finally chosen was suggested to the writer by Dr. Wanderbilt Duarte de Barros. It lay in the upper basin of the River Una and is designated here, in the absence of a local term, the Fortaleza basin after a leading *fazenda* in the area. The Una (Fig. 1) is a right-bank tributary of the Paraíba draining a 200-mile section of the Serra do Mar. Here the monoclinal structure of the Serra do Mar forms a dissected upland tilted towards the Tertiary- and Quaternary-filled rift of the Taubaté basin (Ruellan, 1952). Except where in

Fig. 1. Outline map of Fortaleza basin showing sample watersheds

its lower course the Una breaks through this low ring of Tertiary hills, it is everywhere floored by crystalline rocks of pre-Devonian age.

Taubaté, an old colonial town founded in 1635, formed a convenient centre for work in the Fortaleza basin. Here the writer was fortunate in being allowed access to 1:25,000 air photographs (SVP, 1953) and 1:10,000 cadastral maps (SVP, 1954) covering the basin by the Serviço do Vale do Paraíba, a department of the Transport and Public Works Department of São Paulo State, responsible for the development of water resources in the Paraíba valley. Figure 2 shows a height frequency analysis of the Fortaleza basin from the 1:10,000 map. It brings out the critical land form

division between the flat alluvium filled bottomlands (*varzeas*) and the steeply sloping hills (*morros*) between them. *Varzeas*, about one-twentieth of the ground area, are largely confined to a strip, never more than a kilometre wide, along the Una and its main tributary streams, the Ribeiro de Almas, Ribeiro das Antas, Ribeiro do Pouso Frio and Ribeiro das Sete Voltas. Their average level is at about 600–650 metres (about 2000 feet) and their fall less than 10 feet/mile. The form of the *morros*

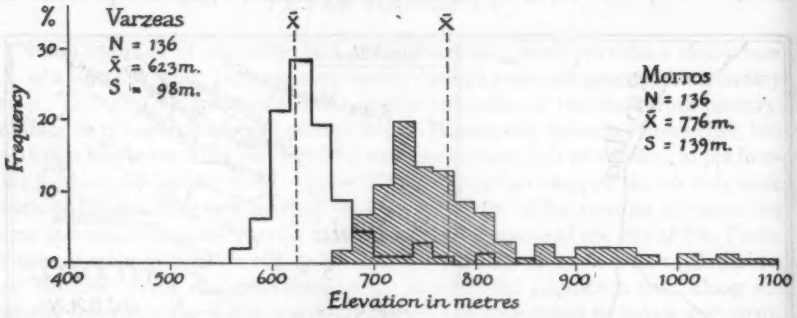


Fig. 2. Frequency curves of height values for the two basic land form types in the Fortaleza basin. Based on 272 sample elevations, 1:10,000 SVP map

reflects the difference between the seven main crystalline rock types. Hills of granite-gneiss, for instance, rise to 900 metres, with slopes up to 80 per cent and radial drainage; while micaschist terrain is more rounded, with slopes up to 70 per cent and rectilinear stream patterns.

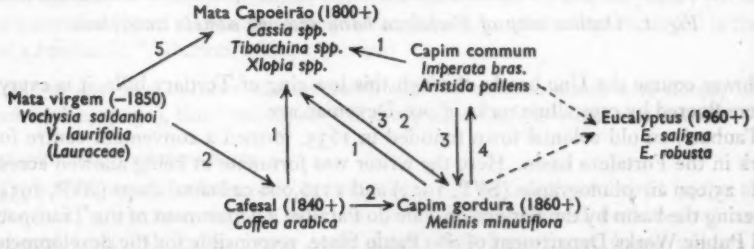
Land use cycle in the test area

Land use in the Fortaleza basin reflects the terrain division shown in Figure 2. The *varzeas* are cultivated for annual crops (varieties of maize, rice, tomatoes and beans) or in pasture, while banana and sugar-cane occupies the adjacent lower slopes. On the *morros*, the pattern was more coarse-grained: blocks of woodland (about one-fifth of the total upland area) alternating with pasture and remnants of *cafesals*.

Table 1 suggests the multiple origin of these two upland vegetation types. Forests are variously designated. None of the original forest cover (*mata virgem*) remains,

TABLE 1

*Tentative reconstruction of land use phases, Fortaleza basin, 1800–**



* For *morro* areas with slopes over 5 per cent. 1. Abandoned. 2. Cleared and planted/seeded. 3. Burnt. 4. Heavily grazed. 5. Cut for charcoal, etc. Species given are representative but not necessarily dominant, and dates are approximated to nearest decade.

but its thinned and degraded remnants continue to be described as *mata*. For the various stages of second-growth forest with their high occurrence of bromeliads (McLean, 1919; Danserau, 1947) there are distinct local terms. How far these local usages are to be trusted has been raised by Sternberg (1949), but in the Fortaleza basin *capoerinho*, *capoeira* and *capoeirão* describe second-growth forests of increasing age.

It is implicit in Table 1 that the Fortaleza basin was *mata virgem* at the beginning of the coffee cycle. Professor C. R. Boxer has pointed out to me the existence of a Colonial mule road along the Una between Taubaté and Ubatuba (Fig. 1, inset), and *roças* were probably cultivated around the way stations on the route. The total effect of such clearing must, however, have been small. The evidence of the seed lists and letters of Bowie and Cunningham, while collecting in the Taubaté area in 1815*, confirm that the area around was forested, though in composition it differed markedly from that of the coast of the Serra do Mar. Hueck (1958) has classed the forest here as originally *Halbtrockenwald* in contrast to the luxuriant *Tropischer Regenwald* of the coast and, although decaying forest vegetation may have given the Una ("Black-water") its name, it is not suggested that the forest was as dense as that cleared around Entre Rios. For it was near there that Stein records land cleared where "the ankle and half the calf sink into the humus" (Stein, 1957); the A_0 horizon in the Fortaleza basin was clearly built on more modest lines.

The second upland element is the heavily grazed rangelands (*Capim* types in Table 1). This consists of two main types. *Capim gordura* or molasses grass (*Melinis minutiflora*, Beauv.) is maintained by annual burning against encroaching shrubs and unpalatable species like *Aristida pallens* and *Imperata brasiliensis*. *Gordura* is the classic successor to the abandoned *cafesal* in this part of the Serra do Mar. As early as 1823, Auguste St. Hilaire (1823, p. 8) had noted that on eroded land: ". . . le terrain se trouve entièrement occupé par une graminée grisâtre . . . qu'on appelle 'capim gordura'," while a more recent source notes that: " . . . on abandoned farmland it rapidly spreads and establishes itself almost to the exclusion of all other vegetation" (Kew Bulletin, 1926, p. 306). Only small acreages of old but still productive *cafesals* remain in the Fortaleza basin (p. 56, below), but the entire rangeland area on the upland slopes is pocked by small hollows (*quadros*) about 3 metres apart indicating the former sites of coffee bushes.

Sample sediment yield areas

The selection of sample localities (Fig. 1) within the Fortaleza basin was determined by the size of the test area (about 25,000 acres) and the time available for field-work in this part of Brazil (three weeks). Table 2 shows that the sample finally selected consisted of six pairs of small watersheds (between 20 and 60 acres in area). For each pair of watersheds, the first, or *control* watershed, was forested and had not been cultivated for coffee (*mata capoeira* type in Table 1); and the second, or *test* watershed, was grass-covered and had at some time since 1840 been cultivated for coffee (*capim* types in Table 1). The watershed was used as the basic sampling unit as it was (*a*) the logical sediment-collecting area; (*b*) provided a large statistical population from within the Fortaleza basin from which the final sample could be drawn; (*c*) could be accurately delimited on the map, and (*d*) readily recognized on air photographs and the ground.

* Dr. G. Taylor of the Royal Botanic Gardens, Kew, has kindly allowed me to examine the MSS letters, journals and collecting lists of James Bowie and Alan Cunningham, preserved in the Herbarium and Library at Kew. Bowie and Cunningham were sent out to Rio by Sir Joseph Banks in December 1814 and, during the next two years, made very extensive plant collections in the Serra do Mar.

Pairing or matching of watersheds was an important process in determining the sample shown in Table 2. Direct comparison of sediment loss or accumulation in

TABLE 2. *Paired characteristics of the 12 sample watersheds*

Characteristic	*Pair* I	*Pair* II	*Pair* III	*Pair* IV	*Pair* V	*Pair* VI
Concentration time (mins.)	14 14	12 12	11 11	11 11	6 6	6 6
Length (hundreds of ft.) ..	24 22	24 22	22 19	22 23	14 17	14 14
Area (acres)	61 59	49 48	44 42	40 40	25 24	23 23
Bedrock	← Micaschist →					
Mean annual rainfall (ins.)	← 55/60 →					

unrelated sets of *mata* and *capim* watersheds would clearly be invalidated by the many variables (other than land use) which affect sediment yield performance (Anderson and Brancroft, 1952). Pairs were therefore selected which were as much alike as possible with respect to three important factors determining sediment yield: concentration time, length and area. *Concentration time* is a measure of the time for stormwater to concentrate within a basin, and was developed some thirty years ago by C. E. Ramser (1927). It has been calculated here from the expression

$$T_c = 0{\cdot}0078 \sqrt{\frac{L^3}{H}}\, 0{\cdot}770$$

where T_c is the concentration time (minutes), L the maximum length of travel (feet), and H the difference in elevation between the most remote point and basin outlet (feet). *Length* is mean watershed length. *Area*, gross watershed area, is an important variable in that, by restricting pairs of watersheds to areas less than 100 acres, the sample was made amenable to a series of empirical formulae developed for small watersheds but as yet untested for larger size units (see below). All three variables were calculated from the 1:10,000 SVP maps. They are ranked in Table 2 in accordance with Maner's correlation coefficients (Maner, 1958). By concentrating the watersheds within a small area, all watersheds could be assumed to have broadly similar rainfall characteristics (i.e. about 55/60 inches/annum, with 45 per cent concentration in the three hottest months). By restricting all watersheds to the micaschist areas within the Fortaleza basin, broadly similar infiltration rates in the lower soil horizons was assumed, and major morphometric contrasts avoided. Small watersheds heavily scarred by landslips (common near Registro) and hillside gullies were excluded from the sample. This bias is not a reflection of the importance of mass movements or gullying in sediment movement but a necessary limitation of the methods of investigation used here.

Primary evidence of sediment yield

As Gottschalk (1957) has pointed out, rapid determination of sediment yield from small catchments must be by indirect means. None of the twelve catchments investigated here had permanent streams so that usual sediment-rating methods were inapplicable, and the three sources of evidence used were (i) soil profiles, (ii) areas of valley fills, and (iii) relict cultivation marks.

Examination of sample pits showed that the soil structure developed under timber on micaschist bedrock was that of a yellow/red latosol. General characteristics of the *massapé* types of soils developed on micaschists have been described by Setzer (1941, 1949), but samples examined in the Fortaleza basin differed from his "Tipo

4a" in having a higher clay content (<0·002 mm) and higher acidity (pH 4·2–4·8) as against Setzer's average of pH 5·0. Despite dryness (little rain had fallen in the basin in the previous four months) differences between horizons were generally clear and that between A_1 and A_2 abrupt.

TABLE 3. *Thickness of Soil Mantle**

$N=12$	*Under* 105 cm	*Over* 105 cm
Test watersheds	4	2
Control watersheds	0	6
	·05>p>·025†	

* A+B horizons only. † Fisher-Yates test. *Biometrika*, 35, 149–54.

In Table 3 the thickness of the combined A and B horizons is shown for the two sets of land use types. On average, the regolith of the test watersheds was significantly thinner than that of the control watersheds (Table 3), at the 95 per cent confidence level, and this difference was consistent with a topsoil loss of 20 cm. ± 5 cm. (about 8 inches). This is equivalent to an over-all loss of about 800 tons/acre since *circa* 1850, or a mean rate of 7–8 tons/acre/annum. Data were obtained by augering an average of five samples and recording for each sample the auger depth

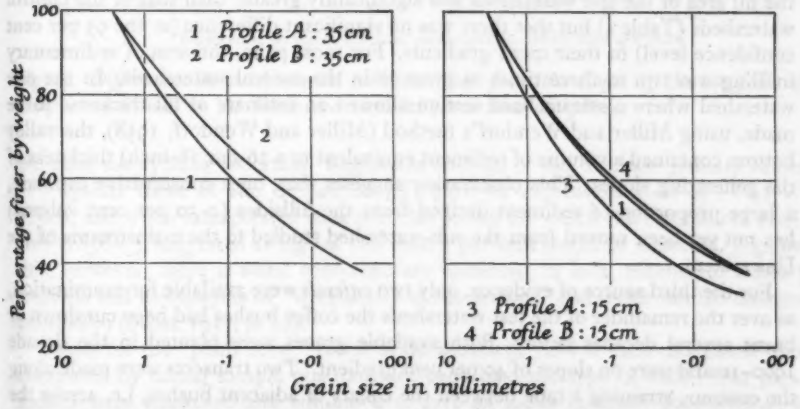


Fig. 3. Grain size distribution curves for A_3 and B_1 horizons from two sample pits in control (Profile A) and test (Profile B) watersheds in Fortaleza basin

at which the C horizon was struck. Auger sites were selected in the middle sections of slopes of about 30 per cent gradient to standardize readings between watersheds and avoid catena distortions. Median readings were adopted as representative of each watershed. Median thickness for all readings under timber (using 10 cm. divisions of the auger) was 110–120 cm., and under grassland, 90–100 cm.

Figure 3 is a grain size analysis at 10 cm. intervals from the two sample pits where full profiles were revealed. These suggested that the closest matching in the B_1 and

A_3 horizons between timber and grass was obtained by a 20 cm. depth displacement. Although this observation is consistent with a hypothesis that some 20 cm. of topsoil had been lost from the test *vis-à-vis* the control catchments, the sample was too small to be statistically significant.

Boundaries of the alluvial fills were plotted on enlarged air photographs in the field. They were marked by abrupt break of slope in the control watersheds, and by absence of *quadros* in the test watersheds. Both criteria when tested by augering across the junction appeared reasonably reliable. Gradients were measured by Watkin clinometer.

TABLE 4. *Area of Valley-Fill Deposits as Percentage of Total Sediment Collecting Area*

$N=12$	*Under* 10 *per cent*	*Over* 10 *per cent*
Test watersheds ..	6	0
Control watersheds	1	5

$.025 > P > .005$*

* Fisher-Yates test. *Biometrika*, 35, 149–54.

Examination of the alluvial and colluvial fills in the valley bottoms suggested that the fill area of the test watersheds was significantly greater than that of the control watersheds (Table 4) but that there was no significant difference (at the 95 per cent confidence level) in their mean gradients. For most pairs, the area of sedimentary infilling was two to three times as great as in the control watersheds. In the one watershed where a stream bank section allowed an estimate of fill thickness to be made, using Miller and Wendorf's method (Miller and Wendorf, 1958), the valley bottom contained a volume of sediment equivalent to a 16-cm. (6-inch) thickness of the generating slopes. This observation suggests that, on a conservative estimate, a large proportion of sediment derived from the hillsides (>50 per cent volume) has not yet been moved from the sub-watershed studied to the mainstreams of the Una system.

For the third source of evidence, only two *cafesals* were available for examination, as over the remainder of the test watersheds the coffee bushes had been cut down or burnt several decades before. Both available groves were planted in the decade 1900–10 and were on slopes of 40 per cent gradient. Two transects were made along the contour, straining a tape between the collars of adjacent bushes, i.e. across the between-row gullies. When differences between this assumed planting level and the actual soil levels between the bushes were examined, their mean value was in both cases one-third–one-half greater than the topsoil loss suggested by the soil profiles.

Secondary evidence of sediment yield

Following Musgrave's pioneer paper (Musgrave, 1947) a number of functional equations have been developed in which sediment yield for a small agricultural area (in tons/acre) is expressed in terms of controlling variables—slope angle, length of slope, soil composition; rainfall intensity, plant cover and management (Smith and Wischmeir, 1955, 1957; Frevert *et al.*, 1955; Rosa and Tigerman, 1951).

Results using Frevert's technique (Frevert *et al.*, 1955) are plotted in Figure 4. They indicate that, for this set of watersheds, differences in mean annual sediment yield are (*a*) greater for larger than smaller catchments, and (*b*) were at their maximum at the height of the *época de café* (*c.* 1850). Since that period the continuing selective cutting of the forests and the replacement of coffee by grasses has brought yields for the two sets closer.

Basic rates for the rainfall band in which the Fortaleza basin lies were obtained from Marques's lysimeter records for different São Paulo locations (Marques, 1951). These were adjusted to mean slope, and length of slope values for each basin; values being determined from a random sample of points within each basin from the 1:10,000 SVP maps. Rainfall intensity values were computed from the values of the wettest month, January, for Taubaté records for the available years 1897–1958. How far it is fair to use these values in computing the *c.* 1800 and *c.* 1850 phases of

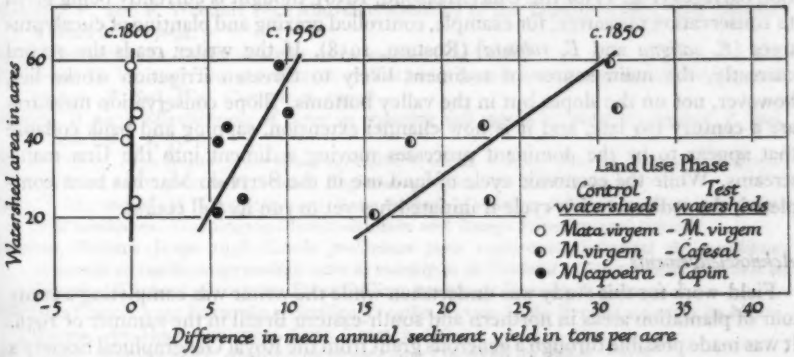


Fig. 4. Differences in mean annual sediment yield from the slopes of the six pairs of sample watersheds in the Fortaleza basin at three land use phases

the land use cycle is uncertain. Regression analysis of the Taubaté January values (Y) against those of Rio de Janeiro (X) gave an expression $Y = 1{\cdot}91 + 1{\cdot}42\ X$, which, and when extrapolated back over the period for which Rio records are available (1856–), suggested swings of less than 5 per cent might be expected. Against this, however, there is some contemporary comment in local nineteenth century journals and newspapers of "irregularity of the seasons" and major rainfall changes from 1859 (Stein, 1957, p. 32).

Values for the "plant cover" factor in the sediment yield of each catchment were computed by taking sample quadrants of each land use type in which four parameters were measured and combined to give an index inversely proportional to sediment yield.* Where examples of the necessary land use type were not available

* The expression used was

$$V_i = \frac{w}{h}\left(\frac{c+g}{2}\right)$$

where V_i is an index of vegetation resistance, w is an estimate of vegetation weight in tons/acre, h is mean canopy height in feet, c is percentage crown cover, and g percentage ground cover. Vegetation was either weighed in the field (rangeland cover) (Brown, 1954) or estimated from trunk diameter (timber cover) (Cottam and Curtis, 1948). The system of combining these values into a single index was suggested by the findings of Kramer and Weaver (n.d.) and Osborn (1954). Since writing this paper, the need for seasonal adjustments of range values and weighing of each variable has become clearer and is being investigated.

within the test area (*mata virgem* and *cafesal*) these were sampled in the nearest available locality.

Conclusion

This paper set out to investigate the relationship of land use to sediment yield during the coffee cycle in a small part of Serra do Mar. The time and resources available determined that such an investigation must be by way of being a reconnaissance, and its findings are similarly restricted in accuracy and universality.

For the small watersheds examined it is clear that felling of the original timber cover and coffee planting resulted (*a*) in the loss of about 20 cm. (8 inches) of topsoil by uniform overland processes, and (*b*) that most of this sediment did not, as Burton supposed, "course to the Atlantic" (Burton, 1869, I, p. 112) but lies as a colluvial apron at the foot of these slopes. In view of the planned system of irrigation barrages (Fig. 1) for the Una (Maksoud, 1958), thought is currently being given to conservation measures; for example, controlled grazing and planting of eucalyptus trees (*E. saligna* and *E. robusta*) (Rostom, 1958). If the writer reads the record correctly, the main source of sediment likely to threaten irrigation works lies, however, not on the slopes but in the valley bottoms. Slope conservation measures are a century too late, and it is now channel extension, sapping and bank collapse that appear to be the dominant processes moving sediment into the Una mainstreams. While the economic cycle of land use in the Serra do Mar has been completed, the sedimentation cycle it initiated has yet to run its full course.

Acknowledgements

Field-work for this study was undertaken while the writer was completing a study tour of plantation areas in northern and south-eastern Brazil in the summer of 1959. It was made possible through a generous grant from the Royal Geographical Society's Latin American Fund, together with financial help from the Anglo-Brazilian Society and the University of Cambridge. A special debt of gratitude is due to Mr. J. M. Miller and his staff, British Council, Rio de Janeiro; to Dr. Wanderbilt Duarte de Barros, Director General, Departamento Nacional da Produção Vegetal, for constant encouragement (and for providing a jeep for field-work in the Fortaleza basin). At Taubaté, every assistance was given by Dr. António Werneck do Carvalho, of the Ministério da Agricultura, and by Dr. António Greff Borba, Dr. Herculano Livramento Prado, Dr. José Alfredo Vieira, Dr. Rubens Jorge Rostom and Dr. Luiz Soares Hungria.

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DISCUSSION

Afternoon Meeting, 18 January 1960

Before the paper, the CHAIRMAN (Sir JOHN TAYLOR) said: The paper of this afternoon is being given by Mr. Peter Haggett, lecturer in Latin American geography at the University of Cambridge. He has devoted himself particularly to Luso-Brazilian

studies and has already made a name for himself as an able geographer. He is at ease in speaking Portuguese, and this stood him in good stead when he visited Brazil last year to study the watershed development in the Paraíba valley of south-eastern Brazil. He is to tell us some aspects of his research there and some preliminary conclusions he has arrived at. His lecture is of more than technical interest as it is the first one assisted by the Latin-American Travel Fund, which is administered by the Royal Geographical Society on behalf of the Institute of British Geographers. The fund was set up in July 1957, to enable university teachers and research students to travel to Latin America on working visits to carry out geographical research and to establish personal contacts with research institutes and opposite numbers in general in these countries, and to arrange for the continuous exchange of data and ideas. That is important for giving our visiting geographers experience and first-hand knowledge of the countries on which they are lecturing. These exchanges contribute to the advancement of science, but I believe you would agree that not the least advantage of these visits is in the wider sphere of personal contacts which build up understanding and confidence between this country and the countries of Latin America and inspire mutual respect. The limiting factor in promoting these visits is finance; mainly for the travelling expenses, as it is often possible to arrange hospitality and various facilities within the country itself. Our Latin-American Travel Fund has started with very modest resources and requires replenishment.

Mr. Haggett then read his paper

The CHAIRMAN: We have got with us this afternoon Mr. J. C. Crossley, the Leverhulme lecturer in Latin American geography at University College, London.

Mr. J. C. CROSSLEY: Anyone in this country who has the opportunity of carrying out geographical investigations in one of the more distant continents is almost inevitably handicapped by restrictions of time or money or both. Frequently people less fortunate or less well-advised than Mr. Haggett find themselves devoting a great part of their time to purely logistic matters concerned with getting to and from a remote area of study and with other non-geographical problems. Mr. Haggett has shown that worthwhile research can be achieved in a limited period provided the area for study is selected in relation to ease of access and to the availability of useful topographical maps (or air photographs), and provided that certain facilities (especially transport) have been arranged in advance.

To anyone passing quickly through the Middle Paraíba Valley today extensive dairy farming is a most striking and apparently anomalous form of land use, when it is remembered that the area lies along the most important economic axis in Brazil, the Rio–São Paulo highway. I wonder whether Mr. Haggett in his investigations found any evidence of a detailed relationship between the present land use and vegetation cover on the one hand and the present characteristics of the soil and subsoil on the other? Again it would be interesting to know whether there has yet occurred on any of the slopes which were severely eroded during the coffee period a regeneration of soil sufficiently great as to permit the re-use of the land on an intensive basis?

Finally, I wonder whether cases have been recorded in the past of the planting of shade trees along with the coffee trees? This practice is virtually non-existent in Brazil today, but is widespread in other Latin-American coffee-growing areas where it helps to check soil erosion. If examples could be found, useful comparisons of sediment yield and rates of erosion under the different conditions might be made.

Professor J. A. STEERS (Cambridge University): I have little to say about the lecture since my interest in South America is very much greater than my knowledge of it. I have travelled the road that has just been mentioned, between Rio de Janeiro and São Paulo, and have flown over that country, and so have a mental impression of what it looks like. But I have been very impressed with the lecture this afternoon because it relates vegetation, or ecology, in general, with soil erosion, and with the physiographical processes. I think the analysis Mr. Haggett gave was most illuminating, even if somewhat beyond me, since I am not used to these new ways of getting at the prob-

lem! A point that I would like to make, however, is this. I think Mr. Haggett has been a successful ambassador to Brazil. We are most anxious in this country, not only from the point of view of geographers but many others too, to know far more about South America than we do, and to be able to teach its geography adequately in our universities and in our schools, so that as many people as possible can get a proper knowledge of what is, after all, one of the most important parts of the world, and certainly one of the parts that is developing most rapidly. It is surprising how ignorant most people in this country are about South America. If others like Mr. Haggett and Mr. Crossley, who has just spoken, are able to go there and do this kind of work, they will in my view achieve a great object.

Mr. B. H. FARMER (Cambridge University): I should like to congratulate Mr. Haggett warmly on his paper and on achieving such a large amount of work in such a short space of time in Brazil. It seems to me that the quantitative, statistical approach to geographical problems that he has so ably demonstrated is bound to have applications in all aspects of geography. Mr. Haggett, if I understand him aright, postulated a state of balance in his valley bottoms before the plantation era, the rivers just being able to remove the waste brought down by processes of mass movement. I doubt if there was necessarily a state of balance. In Ceylon, under virgin forest cover, I have seen heavy landslides bring vast quantities of waste into valley bottoms; if similar or even much gentler movements took place in Mr. Haggett's area in pre-plantation times, there would be a local "waste wedge" whose volume would need to be subtracted from that Mr. Haggett requires to have been brought down in plantation times.

I was interested to hear the conclusion that grass holds more soil than coffee, and nearly as much as scrub forest. This is an important issue, for the *patana* grasslands of Ceylon have by some authorities been debited with a very great contribution to erosion and to consequential silting of reservoirs. It would be interesting to know on what grounds Mr. Haggett reached his conclusions. There are those who, for political and other reasons, find any stick good enough to beat plantation agriculture with; and they may find such a stick in the vast amount of erosion in plantation time in Mr. Haggett's area. This is to neglect the fact that this erosion took place at a time when there was no attempt at conservation. It had been shown experimentally in Ceylon that, with proper graded drains, with the planting of tea in hedges along the contour, and with the establishment of a more or less complete cover of tea under shade trees, run-off and soil loss are actually *less* than from a similar slope under forest.

Mr. C. T. SMITH (Cambridge University): I should like to add my congratulations to Mr. Haggett on his most interesting paper. It seemed to me to be a very stimulating attempt to apply quantitative techniques in a field of study which brings together geomorphology and historical geography in a most profitable way. In a practical way, the techniques which Mr. Haggett has outlined may be of considerable value in other areas of more recent pioneer settlement, in, for example, the Montaña of Peru.

There are two points which I should like to raise. Mr. Crossley has asked about the significance of shade trees in relation to the erosion of coffee plantations, but is it not true, as is shown on Mr. Haggett's illustration of a nineteenth century plantation, that shade trees were not characteristic of Brazilian coffee plantations? Without shade the beans ripened over a shorter period, thus facilitating harvesting by wholesale stripping rather than repeated collection of ripe beans and tending to produce a cheaper but coarser product than, say, that of Colombia.

Secondly, I should like to ask Mr. Haggett about the parallel ridges and gullies into which the coffee plantations were eroded. The diagram illustrating the removal of material from the gullies assumes that the present ridges of the ridge-and-runnel pattern are at the initial surface of the land before accelerated erosion was under way. Is it not likely that a mantle of soil has also been removed from ridges as well, and is it possible that this may be reflected in excessively shallow soils or exposed roots of surviving coffee bushes?

Mr. P. HAGGETT: Before taking up some technical points raised in discussion I should like first to express my thanks to Sir John Taylor and Professor Steers for

encouraging my work in eastern Brazil, and to the Royal Geographical Society, the Anglo-Brazilian Society and my university for financing the visit. Both here and in Brazil I was afforded such generous help by both institutions and individuals that to mention one without all would be churlish. Acknowledgements given in the footnotes to this paper are inadequate thanks for a generosity and kindness as typical as it was undeserved.

Mr. C. T. Smith has already taken up Mr. Crossley's point about shade trees, and certainly my own reading of the nineteenth century agricultural literature supports his view. Shade trees in the remaining coffee lands of the Middle Paraíba exist, but are entirely experimental and still rare.

Mr. Farmer has raised a point on the relative effectiveness of coffee bushes and grasses in holding soil. Here I should emphasize that the nineteenth century practice of the planting of coffee in vertical rows straight up and down the slopes was a conservationists' nightmare. Even today, however, lysimeter readings (at Campinas) suggest that, where slopes are low and angled, and contoured, and storms less intense than in the Fortaleza basin, coffee still yields consistently higher sediment tonnage than most grasses. I agree, however, that I have under-estimated the importance of mass movements. This was by design rather than accident as the particular tools I was using were ill fitted to measure this particular method of sediment removal. In isolating this from the study I have certainly introduced a conscious bias that an alternative approach using different catchments might correct.

The shallow ridge-and-runnel system in some of the plantations mentioned by Mr. Smith certainly raises a knotty problem. In attempting to use the plant collar as a local datum I have used what seemed to be in the field the most reliable level; I would be glad to substitute some more reliable alternative should one exist. This problem is typical of the limitations of this type of reconnaissance study. Measurements made in the field in July 1959 will certainly be replaced by more accurate estimates as more accurate measures and more reliable benchmarks are evolved. That this is but a first approximation of the effect of land use on sediment yield in a part of Serra do Mar is clear; its wide range of tolerance is justified only by the hope that it may encourage second and third order approximations on the same problem in Latin America.

THE HYDROGRAPHY OF START BAY AND ITS RELATIONSHIP TO BEACH CHANGES AT HALLSANDS

A. H. W. ROBINSON

THE DEGREE to which the developing shoreline is influenced by the offshore zone has been the subject of a number of recent studies. Up to the present the main observations have been carried out at places along the East Coast of England. Here, in consequence of the events of the Pleistocene period, there is a considerable thickness of transportable debris existing on the adjacent sea floor. In contrast, in the English Channel the sea bed deposits are thin and over large areas they are absent altogether. This relative paucity of bottom sediment, and the different set of conditions associated with it, must inevitably affect the pattern of shoreline development here and thus afford a contrast with comparable stretches of the North Sea coastlands. Start Bay and the adjacent part of the South Devon coast at Hallsands were chosen for the present study for reasons which will be apparent later.

The bottom configuration of Start Bay.—The form of the sea bed of Start Bay is essentially that of a gently sloping rock shelf lying at a depth of 6–8 fathoms. The outer edge of the shelf is clearly demarcated as a major break of slope with gradients reaching as much as 1:8 until, at depths of 22–24 fathoms, it gradually flattens out to become part of the bed of the English Channel proper. This "submarine cliff" is considerably dissected in places and in the latitude of Torcross a tongue of deeper water penetrates the shelf edge for some distance before ending abruptly in a coomb-like head (Fig. 1). Resting on the shelf near its outer margin is the accumulation of sand and comminuted shell fragments which form the Skerries Bank. In plan the bank has the shape of a half-formed parabola with its nose pointing towards Start Point and two limbs of unequal length running away in a north-north-west direction. The axis of the parabola, corresponding to the slightly deeper water found between the two limbs, does not trend parallel to the shoreline but follows the line of the shelf edge. The least depth recorded during the most recent hydrographic survey was 7 feet and this occurred near its southern extremity. Of greater significance is the fact that the surface of the bank has been fashioned into a number of sand waves (Fig. 2). Two profiles run by *R.V. Sarsia*, kindly placed at the author's disposal by the Director of the Plymouth Marine Laboratory, showed that the waves were best developed near the outer margin of the bank where the accumulation of transportable sediment is probably thickest. The wave height varied from 1 to 17 feet and there was a corresponding increase in wave length from 400 to just over 1000 feet. The waves with the greatest amplitude tend to occur at the northern and southern extremities of the bank and this would be in accordance with the view that changes in depth of the sea bed, leading to perturbations in the water movements over the bank, might influence the development and size of the sand waves (Cartwright, 1959). The echo profiles were fixed with Decca and plotted on a specially prepared chart on a scale of 1:24,000. On this scale the accuracy of fixing is of the order of 30 feet in the area where the vessel was operating. The profiles were run parallel to the long axis of the bank and showed that the sand waves were asymmetrical with a steeper face to the south-south-west. The depths of the crests of the individual waves are extremely variable; they can form at depths of 1–10 fathoms provided that the cover of transportable sediment is sufficiently thick. Between the

Skerries Bank and the shoreline of Start Bay the depth of the sea bed varies between 6 and 8 fathoms and it is probable that the true rock floor of the shelf is everywhere at or near the surface. The bare rock is particularly well exposed where the east–west trending ridges of the mainland run out to sea off Tinsey Head, Torcross Point and, in the south, near Start Point. Bare rock ribs are also common along the shoreline itself at these points. The shoreline throughout is steeply shelving and depths of 6 fathoms are quickly reached offshore.

Bottom sediments.—The accompanying map of the sea floor deposits, constructed mainly from information contained on the unpublished hydrographic surveys of the bay, shows that the dominant deposit is sand (Fig. 3). The sand is not of uniform grain size throughout and there are significant changes, particularly on the Skerries Bank. This variation within the Skerries is also shown in the series of bottom samples (numbered 1–10) obtained by *R.V. Sarsia* during the recent hydrographic examination referred to above. The sampling sites were chosen to ensure as complete a cover as possible of the Skerries Bank, bearing in mind the limited scope of the investigation. The samples obtained from the outer edge (numbers 1–5) were of coarse sand with a varying percentage of shell fragments. When followed towards the shore the sand becomes finer, particularly in the area of the north-west quadrant of the bank (samples 8–10). At sampling site 6, along the inner margin of the parabolic nose, the two types of sediment are mixed together.

The samples were analysed for grain size, using a stainless steel sedimentation column of the van Veen pattern having a length of 7 feet and internal diameter of 6 inches (Van Veen, 1937). The sediment, slightly moistened before insertion at the top of the column, was allowed to fall freely through a column of water 200 centimetres in length and its rate of accumulation was measured. Cumulative frequency curves were then constructed using a modified form of Stokes, original formula for the rate of fall of rounded sand grains of density 2·625. Throughout the measurements the temperature of the water in the column remained at 61° F. From the cumulative curves of the various samples, some of which are shown in Figure 4, it is possible to learn more about the grain size characteristics using the standard methods of statistical analysis. The median value M (50 per cent on the frequency ordinate), the lower and upper quartiles Q_1 and Q_2, corresponding to frequency values of 25 per cent and 75 per cent respectively, can be read directly from the graph. Using these values, the coefficient of sorting (So) and the coefficient of skewness (Sk) can be calculated to provide further information. The values for the Skerries samples are given in the following table:

Sample number	*Median* 50 *per cent*	*Lower Quartile* 25 *per cent*	*Upper Quartile* 75 *per cent*	*Sorting coefficient* $(Q_1/Q_2)^{\frac{1}{2}}$	*Skewness coefficient* $(Q_1 . Q_2/M^2)$
1	640μ	750μ	525μ	1·20	0·961
2	590	715	465	1·24	0·955
3	690	810	565	1·20	0·961
4	525	680	416	1·28	1·026
5	725	830	650	1·13	1·027
6	660	785	545	1·20	0·982
7	510	630	395	1·26	0·957
8	270	340	220	1·25	1·027
9	280	350	230	1·23	1·027
10	200	260	160	1·27	1·041

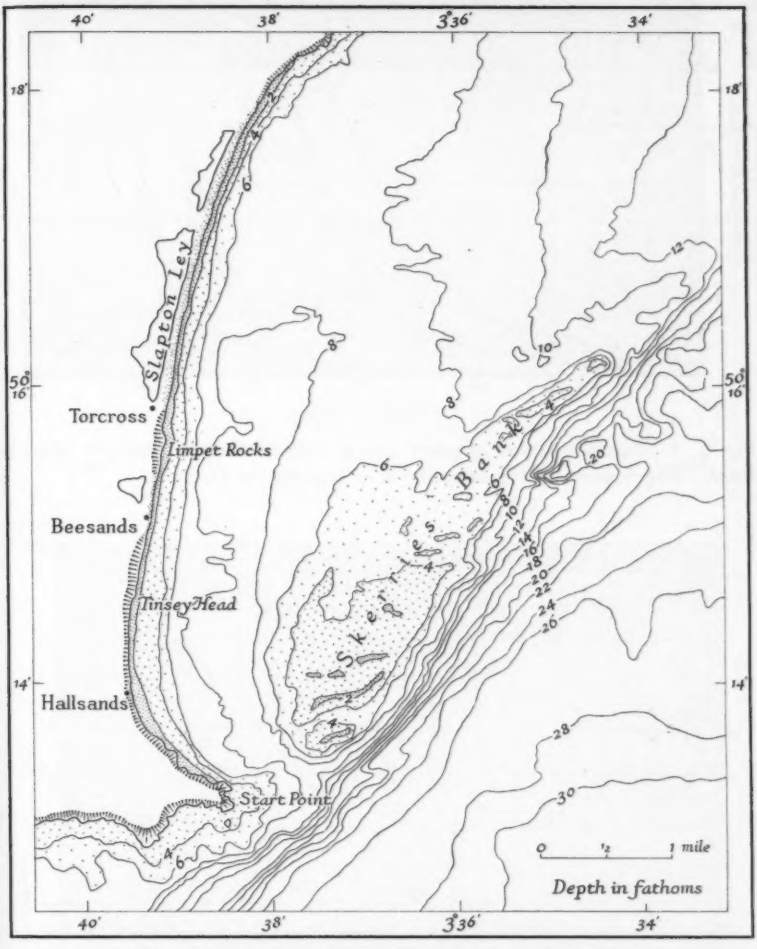

Fig. 1. The submarine configuration of Start Bay

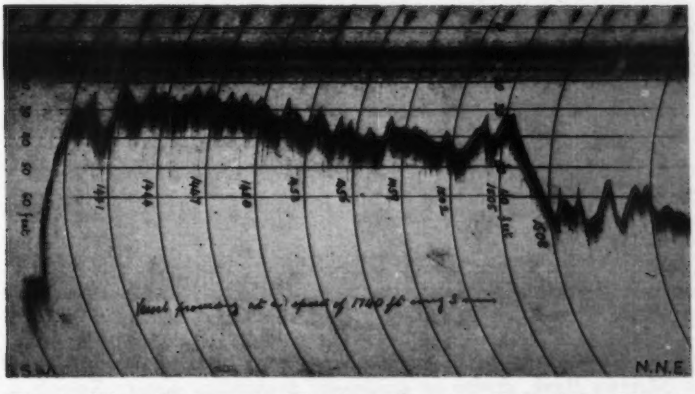

Fig. 2. The echo trace profile along the outer limb of the Skerries Bank parallel to its long axis. Asymmetrical sand-waves have a vertical exaggeration of 1:116

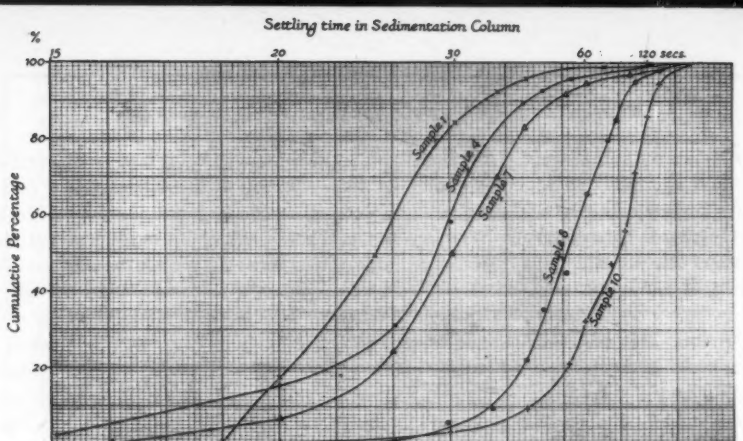

Fig. 4. Cumulative curves of grain size of various samples from the Skerries Bank. The position of the sampling sites is given on Fig. 3

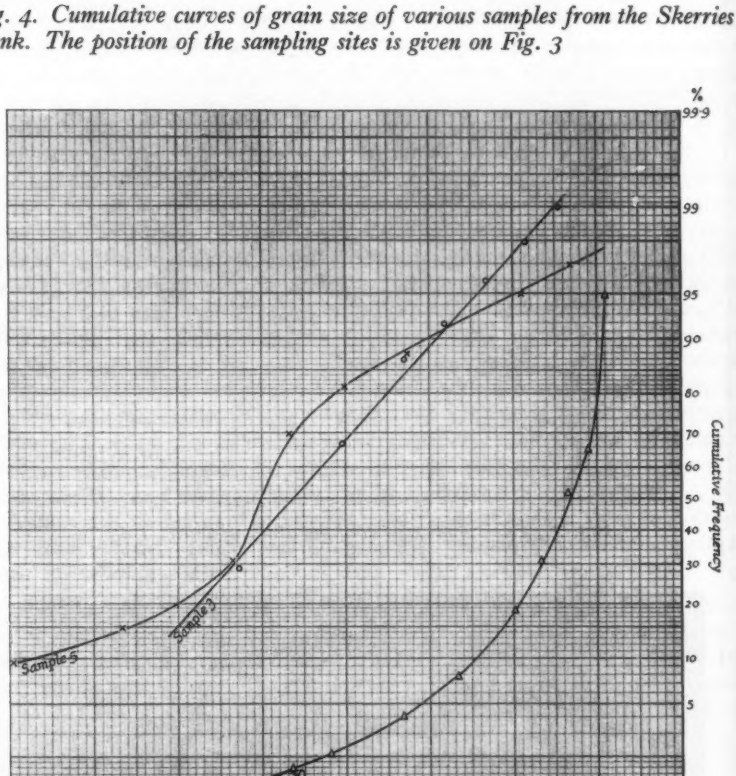

Fig. 5. Cumulative curves for the three main types of sediment found on Skerries Bank, drawn on arithmetic probability paper. Sample 3: normal grain size distribution; Sample 5: mixture of two sediment types; Sample 10: has an asymmetrical grain size curve with some of the sediment washed out

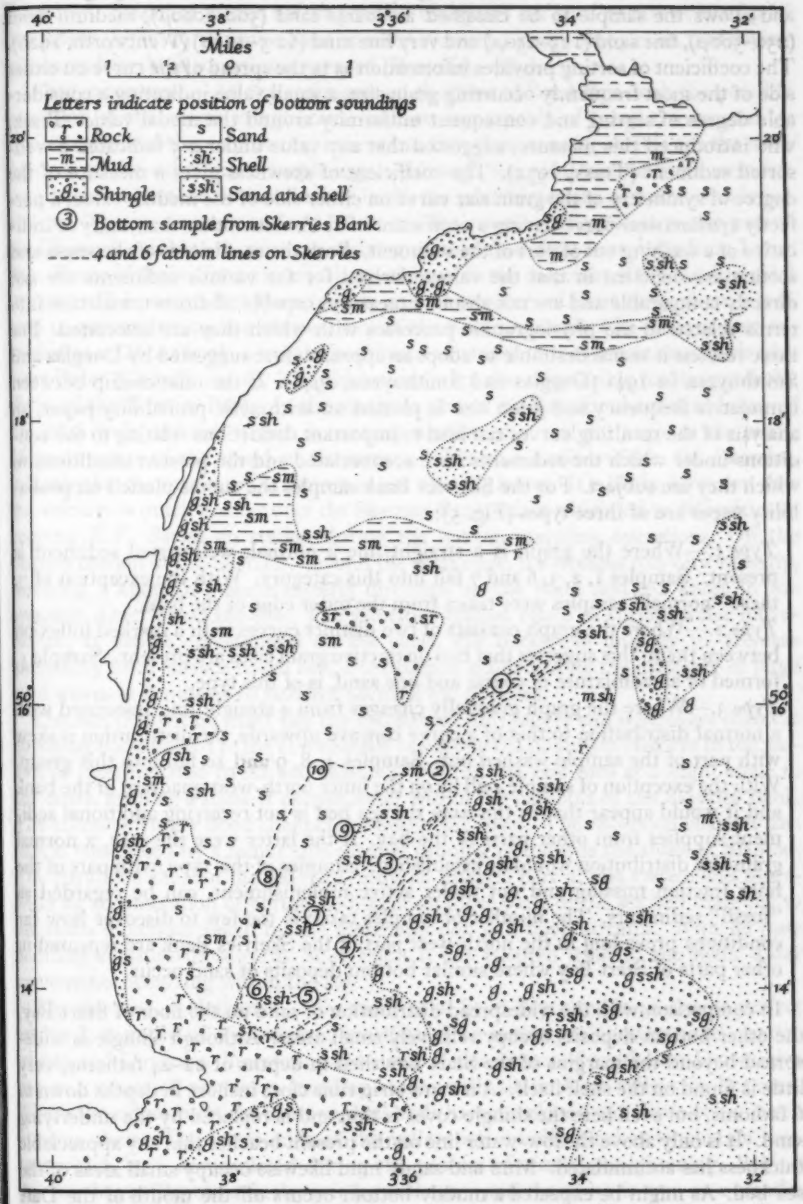

Fig. 3. The bottom deposits of Start Bay. Numbers on the Skerries Bank refer to samples obtained from the sea bed

The median value is useful in that it gives an indication of the average grain size and allows the sample to be classified as coarse sand (500–1000μ), medium sand (250–500μ), fine sand (125–250μ) and very fine sand (62·5–125μ) (Wentworth, 1926). The coefficient of sorting provides information as to the spread of the curve on either side of the most frequently occurring grain size, a small value indicating a considerable degree of sorting and consequent uniformity around the modal value. Trask, who introduced this measure, suggested that any value under 2·5 indicated a well-sorted sediment (Trask, 1932). The coefficient of skewness gives a measure of the degree of symmetry of the grain size curve on either side of the median value, a perfectly symmetrical curve having a coefficient of 1. A value other than unity is indicative of a washing out of part of the sediment. Both the coefficients of skewness and sorting are deficient in that the values derived for the various sediments are not directly comparable and are not absolute measures capable of direct translation into terms related to the physiographic processes with which they are associated. For these reasons it seems desirable to adopt an approach first suggested by Doeglas and Smithuyzen in 1941 (Doeglas and Smithuyzen, 1941). If the relationship between cumulative frequency and grain size is plotted on arithmetic probability paper, an analysis of the resulting curves can lead to important deductions relating to the conditions under which the sediments have accumulated and the present conditions to which they are subject. For the Skerries Bank samples the curves plotted on probability paper are of three types (Fig. 5):

Type 1.—Where the graph is a straight line a normal, well-sorted sediment is present. Samples 1, 2, 3, 6 and 7 fall into this category. With the exception of 7, these "normal" samples were taken from the outer edge of the bank.

Type 2.—Where the graph consists of two distinct curves with a marked inflexion between them, this suggests that two distinctive grain sizes are present. Sample 5, formed of an admixture of coarse and fine sand, is of this type.

Type 3.—Where the graph gradually changes from a straight line associated with a normal distribution to that of a curve concave upwards, the distribution is skew with part of the sample washed out. Samples 4, 8, 9 and 10 fall into this group. With the exception of sample 4 all lie on the inner north-west quadrant of the bank and it would appear that in this area the sea bed is not receiving additional sediment supplies from other parts of the bay. If the latter were the case, a normal grain size distribution would be established. Samples of this type, with part of the finer fraction missing and not under active replenishment, can be regarded as "fossil" sediments. The number of samples taken is too few to discover how far conditions prevailing in the north-west part of the Skerries Bank are repeated in other parts of Start Bay where similar bottom deposits of sand occur.

In comparison with the widespread distribution of sand on the floor of Start Bay, the other bottom deposits occupy relatively small areas. Although shingle is widespread beyond the margins of the Start Bay shelf in depths of 22–24 fathoms, very little is found on the shelf itself. A narrow strip runs close inshore in depths down to 6 fathoms, but even here the shingle cover is thin and is replaced by the underlying sand. It is only above the low-water line on the present beaches that any appreciable thickness has accumulated. Mud and sandy mud likewise occupy small areas of the sea bed. As might be expected a muddy bottom occurs off the mouth of the Dart estuary. Of greater interest are the two elongated strips of sandy mud running out from the coast in the latitudes of Slapton and Blackpool. As these continue the line of valleys on land, it is interesting to speculate on the possibility that the sea bed sediments here represent the remains of terrigenous deposits which have as yet been

only partly modified in the period since the last rise of sea level which created Start Bay. Evidence of this recent positive change of sea level occurs at Blackpool Bay where, after storm waves have combed down the beach shingle, an underlying submerged forest is sometimes exposed (Pengelly, 1869).

Water movements.—All the sediments on the floor of Start Bay, with the possible exception of the coarse shingle close inshore, are capable of being transported by tidal streams and there are strong indications that these are responsible for the main features of the submarine morphology. Although few tidal stream measurements have been undertaken within the bay itself, the general pattern of water circulation is clear. The promontory of Start Point, and the coastal configuration in this part of the Channel, combine to create an eddying motion extending westwards from Lyme Bay. Some of the sediment in transit up-channel in the direction of the residual tidal streams will be swept into the relatively quiescent waters of Start Bay, where it will tend to accumulate on the seaward face of the Skerries shoal. The latter is best regarded as a banner bank, owing its continued existence to the protection afforded by Start Point (Cornish, 1914). The tidal streams are also responsible for the parabolic shape of the Skerries Bank. In the southern part of the Bay, for about nine hours of the tidal cycle, the ebb stream is running southward at a slight angle to the coast. Measurements of the speed of the stream, taken at a station within the Skerries, indicate that the maximum at springs is less than 1·5 knots. It is likely, however, that the velocity is much greater over the Skerries Bank, a fact which led to difficulties in keeping *R.V. Sarsia* on station during the bottom-sampling operations. Off the eastern margin of the Skerries, beyond the shelf edge, the streams run very strongly, reaching 3 knots in a north-easterly direction on the flood and 2·2 knots in the opposite direction on the ebb. The velocities quoted relate to surface water movements; at depths encountered on the shelf, the velocity is unlikely to decrease noticeably from surface to sea bed, a conclusion confirmed by the existence of large sand waves at depths of 10 fathoms north of the Skerries.

The fact that within Start Bay the ebb stream runs longer and is stronger than the opposing flood has led to the ebb channel becoming the dominant element in the pattern of interdigitated banks and channels (Fig. 6). Its axis runs at a slight angle to the coast, forming a sinus of deeper water within the parabola of the Skerries Bank. The complementary flood channel lies nearer the coast. The ebb-flood channel pattern is completed by a minor ebb channel running in towards the shore at Slapton. The parabolic shoal of the Skerries forms an integral part of this system and represents an accumulation of bottom sediment on those parts of the sea bed marginal to the main directions taken by the maximum ebb and flood streams. With its nose pointing southwards towards Start Point it has adapted itself to the main water movements occurring within the bay.

The shoreline at Hallsands.—The margins of Start Bay provide an almost perfect textbook example of a discordant coastline. The metamorphic mica- and quartz-schists and Devonian limestones and slates of this corner of south-east Devon give rise to a series of east–west trending ridges with short steep valleys in between. Where the ridges meet the coast vertical cliffs have developed with little or no beach fronting them. The lower ends of the valleys are usually blocked by shingle bay-bars which have accumulated during the process of coastal straightening. Behind the bay-bar at Slapton a freshwater ley still exists and the same is true on a smaller scale at Beesands further south. At Hallsands the former ley has been completely infilled and now supports a vegetation of pollarded willows. It is in these sections of the coast, where the valleys reach the sea, that the beaches attain their greatest development.

The beach at Hallsands was studied in detail during 1956 and 1957, using measured profiles at various intervals to obtain information about the changes of level to which it was subject. Hallsands was chosen because between 1903 and 1923

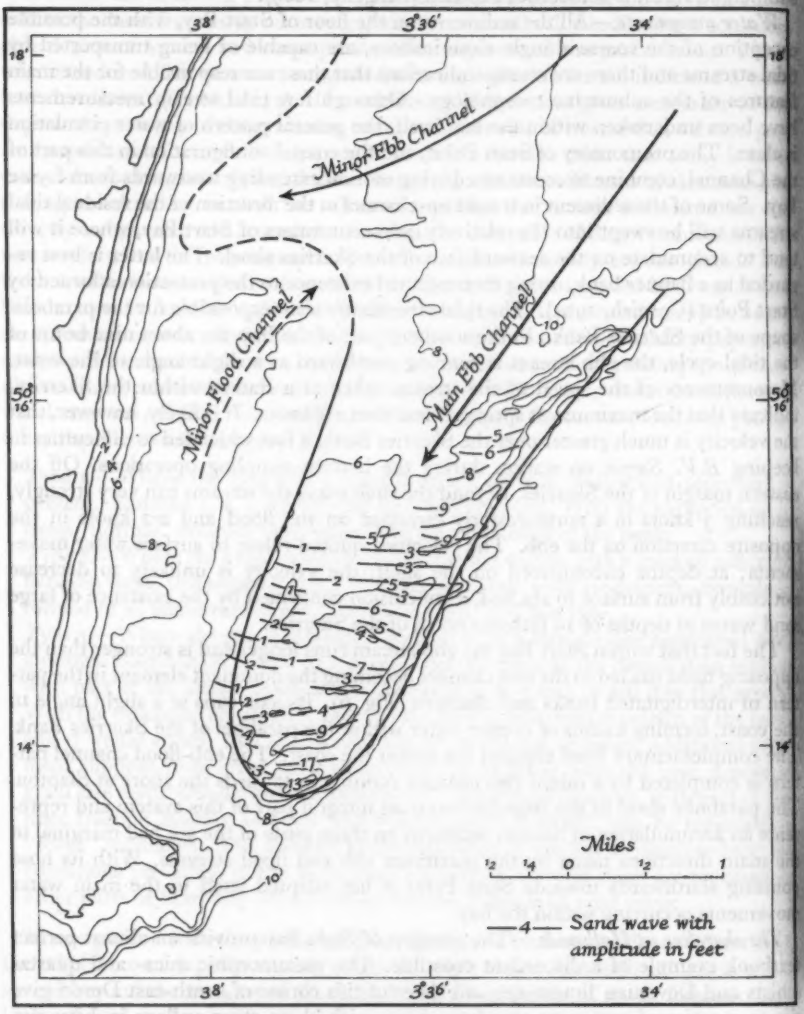

Fig. 6. Ebb-flood pattern of banks and channels in the southern part of Start Bay; associated sand waves of the Skerries Bank are also shown

Hansford Worth had carried out a similar set of measurements and his results were therefore available for comparison. It was thus possible to assess the long term changes in beach level as well as the changes taking place at present. The circumstances which led Hansford Worth to carry out his detailed observations in this area are fully recorded in a series of papers in the *Transactions of the Devon Association*

Hallsands beach looking north; ruined village in foreground and Wilson's Rock a little offshore

Bay-bar of the Greenstraight; Tinsey Head in the distance

Cliff section of the beach with well-developed marine abrasion platform almost completely bared of shingle, April 1960

Southern end of the beach with shingle backed by the 25-foot wave cut bench on which Hallsands was originally built

(Hansford Worth, 1904, 1909, 1923). Briefly, the sequence of events as recorded by him was as follows. In 1897 a local contractor obtained permission to remove shingle from the foreshore at Hallsands and, using a dredger on the rising tide, almost half a million cubic yards of shingle were taken for dockyard works at Devonport. The exploitation ended in 1902, when the Board of Trade licences were withdrawn, but by this time the beach had been lowered by as much as 12 feet throughout its length. Subsequently, considerable damage was caused to houses in the fishing hamlet of Hallsands by waves breaking higher up the beach than previously. In the years which followed Worth kept a close check on the fluctuating levels of the denuded beach, and to this end he established six section lines which he levelled on a number of occasions between 1903 and 1923. In the first paper in the *Transactions of the Devon Association*, Worth included a map on a scale of 1:5000 showing the positions of his six section lines and thus it was possible to re-occupy and re-survey the same profiles during 1956 and 1957.

The section of the coast at Hallsands under review falls into three distinct parts (Fig. 7). Across the mouth of the Bickerton valley, near the site of the present village, there is the bay-bar known as the Greenstraight. The small stream draining the valley has been blocked at its mouth and, except under flood conditions, the water seeps through the shingle beach. The steeply shelving beach is 140 feet wide in this section and usually has a number of recently formed fulls extending along its length. Further south, the beach narrows considerably and is backed by almost vertical cliffs of micaschist with numerous quartz veins running through them. At high water the lower parts of the cliff are under direct wave attack. The beach here is very superficial and, after a period of destructive wave action, the shingle may be combed down and the underlying rock ribs exposed. During the last half century there has been a surprising amount of cliff recession in this section. The schists are intensely faulted and thrusted with the result that wave action has been able to exploit zones of weakness in what otherwise would be a very resistant rock type. Numerous clefts have been opened up at the base of the cliff where it is subjected to attack at each high water, and in time the whole of the face is undermined and it collapses. Since the publication of the 6-inch Ordnance Survey map in 1907 the cliff-top adjacent to the Coastguard Cottages has receded by as much as 20 feet.

This cliffed coast gives way further south to a stretch of shoreline where a pronounced raised beach platform, 21–24 feet above Ordnance Datum, fronts the lower part of the cliff. In places, the wave-cut bench is overlain by a considerable thickness of head, and at two points raised beach deposits, with bands of rounded pebbles, have been preserved under the head material. The original fishing hamlet of Hallsands was built on this rock platform. The shelf is backed by steeply sloping cliffs fashioned by marine forces at the time of its formation but subsequently modified by solifluction.

Throughout the section under review the beach is composed of shingle with occasional patches of fine sand exposed at extreme low water. The shingle is of variable size, although there is a tendency for the smaller pebbles (about 1 inch in diameter) to occur in the south while larger pebbles (about 3 inches diameter) make up a larger percentage of the total in the area of the Greenstraight. A series of

Local	*Non-local*
Micaschist 2 per cent	Chalk flints 73 per cent
Quartzite 16 per cent	Dartmoor felsite 5 per cent
	Dartmoor slate 2 per cent
	Granite 2 per cent

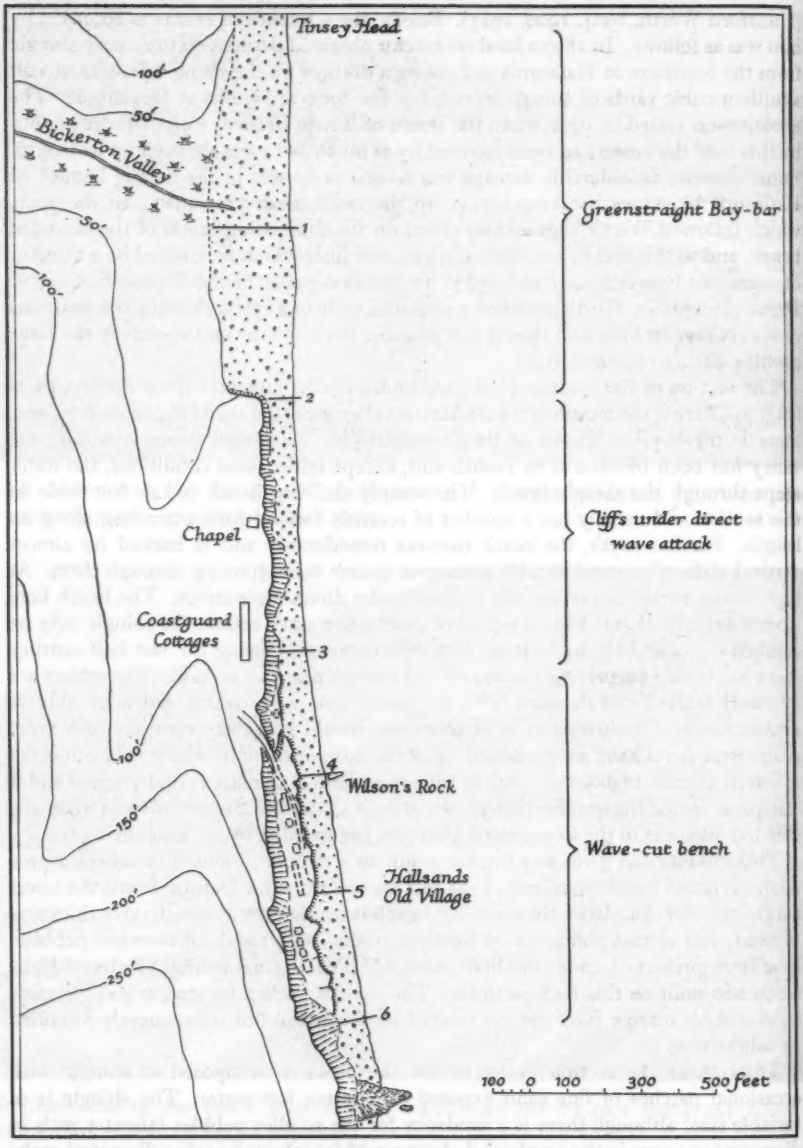

Fig. 7. The beach at Hallsands showing the position of section lines used in the study of the changing beach profiles

pebble counts showed that six main rock types, local and non-local, were represented. As can be seen from the table, chalk flints make up almost three-quarters of the total. The nearest sources are the Haldon Hills 25 miles to the north and the bed of the English Channel 20 miles to the east, well beyond the limits of the Start Bay shelf.

The significance of this high percentage of non-local rock types will be referred to later when the role of the offshore zone in shoreline development is discussed.

Changes in the beach profiles.—The profiles used by Hansford Worth in his study of the changes in beach level covered all three distinct sections of the Hallsands beach. Section 1 ran across the Greenstraight near the point where the small stream draining the Bickerton valley seeps through the beach. Sections 2 and 3 were located in the middle section and ran from the cliff base to the low-water line. The remaining sections were in front of the wave-cut bench and again ran out to the low-water line. When Hansford Worth first levelled his profiles in 1903 it was across a beach which had already been considerably depleted of shingle. Although no direct measurements had been undertaken previously, the extent of the lowering could be estimated from photographs taken before and after the exploitation. Wilson's Rock, previously almost covered by the shingle of the beach, now stood as a stack 14 feet high, indicative of a lowering of about 12 feet in this part of the beach. Although the amount of lowering varied along the whole length of the beach, it everywhere exceeded 10 feet. When permission was granted by the Board of Trade to remove some of the shingle, it was assumed that natural processes would quickly build up the beach to its former level. From the outset, Hansford Worth had argued that this was unlikely and in the years which followed his own measurements of the changing beach level confirmed his views.

The oscillations of beach level measured by Worth together with those recorded in recent years are shown in Figure 8. The following comments are intended to supplement the information shown on the plotted sections.

Section 1.—From 1903 to 1907 some upbuilding took place, but the great storm surge of January 1917 led to a further lowering of between 2 and 4 feet. The beach has never really recovered from this depletion. As this part of the beach is backed by the open Bickerton valley, some landward movement of the whole bay-bar has occurred with the result that the lowering might be more apparent than real.

Section 2.—The early profiles show that some accretion of the shingle was taking place, but as this amounted to less than two feet, it could be accounted for by seasonal oscillations of beach level. As with Section 1, the severe storm of 1917 led to a great lowering—by as much as 5 feet at one point—and further depredations have taken place since. The lowest level yet recorded was in April 1956 when the basal rock platform was laid bare following the winter storms. Subsequent upbuilding has taken place during 1956 and 1957 but these seasonal oscillations are not of great magnitude.

Section 3.—A steady lowering has occurred from 1903 onwards with the lowest level reached in April 1956, the same as at Section 2. As both these section lines are located where the beach is backed directly by the cliff face, and the base of this is reached even during high water neap tides, there is a greater tendency for a combing down of the shingle here than elsewhere.

Section 4.—Lying opposite Wilson's Rock, this part of the beach has shown remarkable stability since the low level reached after the 1917 storm. During the past forty years it has not varied by much more than a foot in level. This suggests that, after the beach had adjusted itself to the new nearshore conditions, a stable graded profile was attained.

Section 5.—The beach here was lowered consistently between 1907 and 1917, but since that time some slight upbuilding has taken place. As at section 4, the recent seasonal changes are slight.

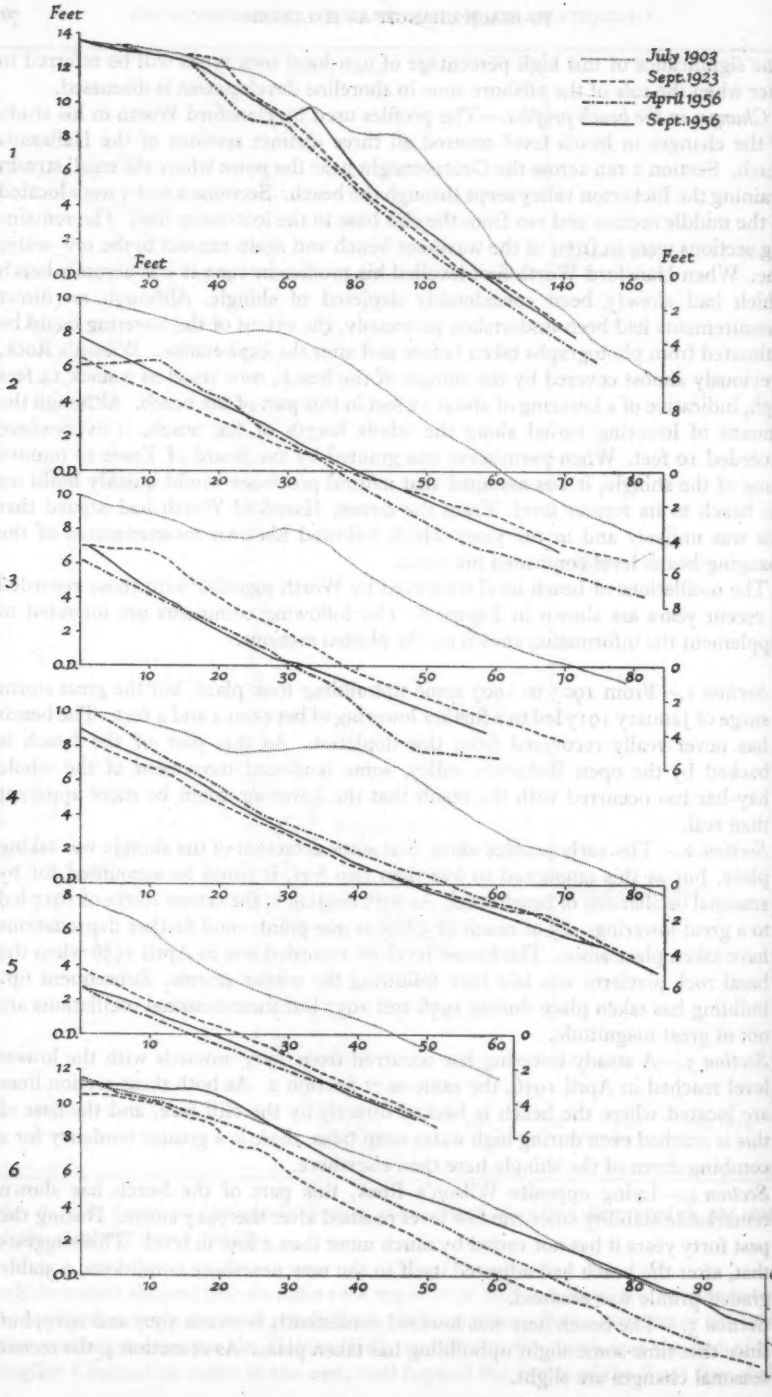

Fig. 8. The changes in beach profiles along Sections 1–6 between 1903 and 1956. Vertical exaggeration for Section 1 is 1:5 and for remainder 1:2·5

Section 6.—The oscillations along this profile are somewhat different from other parts of the beach. The lowest level was again that recorded in 1917, but since that time a considerable gain has been made with the result that by April 1956 it had recovered to the level it had in 1903.

The measurements made by the author during April and September in both 1956 and 1957 indicate that the seasonal fluctuations of beach level are not of great magnitude. As might be expected, the general lowering during the winter months was followed by a period of upbuilding during the succeeding summer, although there were exceptions to this in certain parts of the beach. Reference to Figure 9, showing the recent changes along profile 4, make it clear that when the oscillations of beach level are as small as a foot the effects of a recent storm might be more apparent than the longer term seasonal changes. During the summer of 1956 the beach at Section 4 was built up slightly throughout its length. The succeeding winter led to a lowering of about two feet on average and this was followed by a further lowering of half a

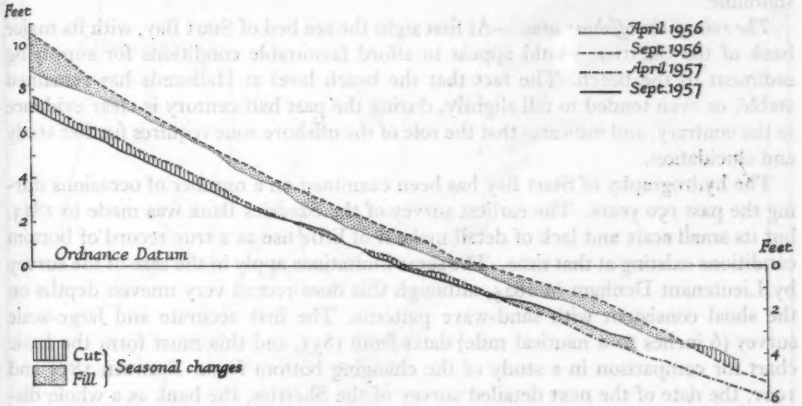

Fig. 9. The seasonal changes of beach level along Section 4 during 1956 and 1957

foot at the upper end of the beach. It must be stated however that when the section was re-levelled in September 1957, storm conditions with destructive waves breaking on the beach had prevailed for a week previously.

The lowest level ever attained by the beach was recorded in April 1960 when a further series of profiles was measured; none of Hansford Worth's sections showed such a marked depletion of the shingle. At Section 4, near Wilson's Rock, the shingle had been completely removed to expose the underlying rock ribs. Only in pockets between the rock outcrops was there any superficial sediment cover and this consisted of gritty sand rather than shingle. The level here was on average one foot lower than in April 1957, itself a time of general depletion of the whole beach at Hallsands. Prior to the measurements of April 1960 a prolonged spell of easterly weather had affected this coast with the result that destructive waves had combed down the shingle. It is unlikely, however, that this shingle is permanently lost to the beach for, given suitable conditions leading to constructive wave action, the material at present lying just offshore will be carried on to the beach once again.

It is clear from the observations made by Hansford Worth, supplemented by the recent re-surveying of his sections, that no extensive supply of material is available

to re-establish the beach at its pre-1897 height and width. The beach could, theoretically, receive replenishment from the adjacent coast by longshore drifting, or from the adjoining sea bed by direct onshore movement. Of these two possible methods of supply beach drifting would seem to be least likely, bearing in mind the local conditions along this part of the South Devon coast. The discordant nature of the coastline, with prominent headlands and their associated reefs running out into the deeper waters of Start Bay, effectively limits the lateral transference of beach material both above and below the low-water line. Start Point reduces the effect of the prevalent south-west wind to negligible proportions with the result that the characteristic east-north-easterly beach drifting of much of the Channel coast is not apparent in Start Bay. Between the projecting headlands the individual beaches display a very variable direction of movement of the beach deposits and at any one time reflects the prevailing conditions of wave approach. The lack of consistency in the changes of beach level along the six section lines is in accordance with the view that there is no dominant direction of beach drift along this part of the Start Bay shoreline.

The role of the offshore area.—At first sight the sea bed of Start Bay, with its major bank of the Skerries, would appear to afford favourable conditions for supplying sediment to the beach. The fact that the beach level at Hallsands has remained stable, or even tended to fall slightly, during the past half century is clear evidence to the contrary, and indicates that the role of the offshore zone requires further study and elucidation.

The hydrography of Start Bay has been examined on a number of occasions during the past 150 years. The earliest survey of the Skerries Bank was made in 1813, but its small scale and lack of detail make it of little use as a true record of bottom conditions existing at that time. The same limitations apply in the case of the survey by Lieutenant Denham in 1824, although this does record very uneven depths on the shoal consistent with sand-wave patterns. The first accurate and large-scale survey (6 inches to a nautical mile) dates from 1853, and this must form the basic chart for comparison in a study of the changing bottom form. Between 1853 and 1921, the date of the next detailed survey of the Skerries, the bank as a whole displayed a remarkable degree of stability considering that it is formed of sediment capable of transport by tidal streams of relatively low velocities. The only significant changes occurred at the extremities of the bank. In the north-east the tail moved landward by an average of about 150 feet. Along the southern margin the movement was greater, amounting to between 400 and 500 feet (as measured by the position of the 3-fathom line on the two surveys). The only other noticeable change occurred along the inner edge of the bank opposite Hallsands, where the inner limb of the parabola almost disappeared as the 4-fathom line retreated away from the coast. This development was only temporary, for by 1951, the date of the most recent and detailed survey of Start Bay, the inner limb had succeeded in re-establishing itself and was even more pronounced than at the time of the 1853 survey (Fig. 10). The other changes noted above continued with the same trend between 1921 and 1951 with the result that the southern nose of the bank was now another 200–400 feet nearer Start Point. Again, no significant movement of the inner edge of the bank towards the shore was recorded except that associated with the re-forming of the inner limb referred to above.

The changes in the submarine morphology which had taken place between 1853 and 1951 suggest a movement of the bottom sediment in the direction of the dominant ebb stream. This line of evidence, taken in conjunction with the asymmetrical profiles of the sand waves developed on the bank and the character and distribution

of the sediment types, is in accord with the thesis that tidal streams have been responsible for fashioning and maintaining the present submarine features of Start Bay. It would appear that the effectiveness of waves in transporting the bottom sediment is secondary to that of the tidal streams. The bay is very open between north-east and south-east and, although winds from this direction are infrequent (amounting to about 14 per cent of the total), the length of available fetch is such that considerable waves can be generated when the wind is in an easterly quarter. Even with a moderate sea running the bottom sediment will be stirred up by breaking waves on the

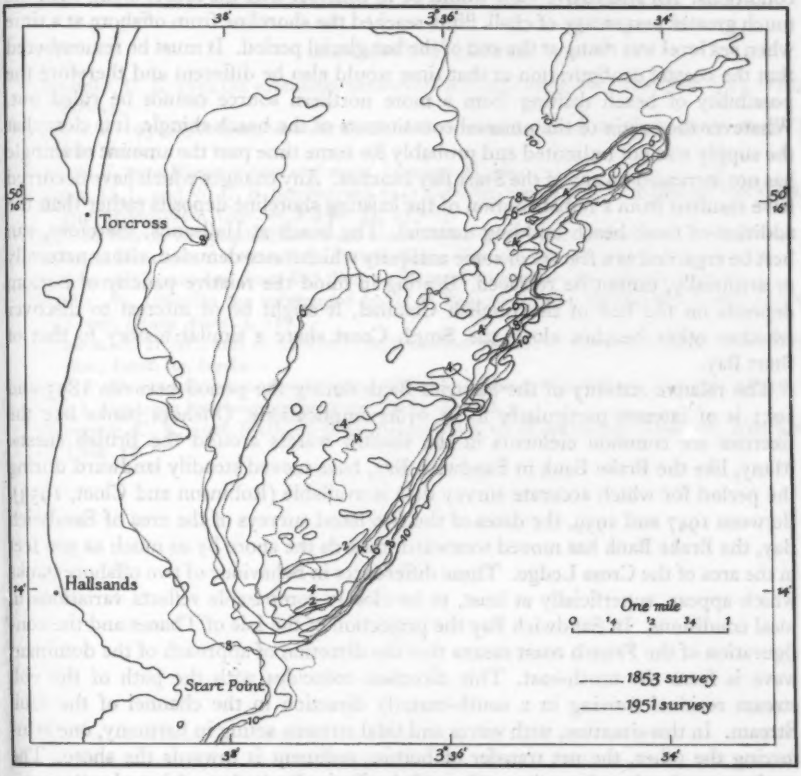

Fig. 10. A comparison of the sea bed contours as recorded on the two large-scale and accurate surveys of the Skerries Bank made in 1853 and 1951

shallower parts of the Skerries Bank. The lateral transfer of sediment towards the shore, that is in the direction of the dominant wave approach, would appear to be severely limited, otherwise the bank would show a consistent movement in this direction. Once the sediment is in suspension it is carried in the direction of the dominant tidal stream parallel to rather than towards the shore. The beaches of Start Bay, in consequence, cannot look to the offshore zone as a major source of sediment supply, a fact always stressed by Hansford Worth in his efforts to prevent the removal of the shingle from the beach at Hallsands. The analysis of the grain size of samples obtained from the Skerries Bank also points to a deficiency of

sediment supply on the sea bed itself, at least along the inner margin of the bank (samples 8, 9 and 10).

In the absence of any comparable deposits on the floor of the Start Bay shelf, the origin of the shingle found on all the beaches presents a problem. As has been noted previously the greater part of the shingle on the beach at Hallsands is made up of non-local rock types. Of these the Dartmoor felsite is of great interest. Worth considered that its presence indicated that the beach was of some antiquity, for it was unlikely to reach its present position by beach drifting southwards under existing conditions. An alternative view would be to consider that the felsite along with the much greater percentage of chalk flints reached the shoreline from offshore at a time when sea level was rising at the end of the last glacial period. It must be remembered that the coastal configuration at that time would also be different and therefore the possibility of beach drifting from a more northern source cannot be ruled out. Whatever the origin of the unusual constituents of the beach shingle, it is clear that the supply was not unlimited and probably for some time past the amount of shingle has not increased on any of the Start Bay beaches. Any changes which have occurred have resulted from a redistribution of the existing shoreline deposits rather than the addition of fresh beach building material. The beach at Hallsands, therefore, can best be regarded as a feature of some antiquity which, once denuded, either naturally or artificially, cannot be replaced. Bearing in mind the relative paucity of bottom deposits on the bed of the English Channel, it might be of interest to discover whether other beaches along the South Coast share a similar history to that of Start Bay.

The relative stability of the Skerries Bank during the period between 1853 and 1951 is of interest particularly in its wider implications. Offshore banks like the Skerries are common elements in the shallow waters around the British coasts. Many, like the Brake Bank in Sandwich Bay, have moved steadily landward during the period for which accurate survey data is available (Robinson and Cloet, 1953). Between 1947 and 1959, the dates of the two latest surveys of the area of Sandwich Bay, the Brake Bank has moved westward towards the shore by as much as 500 feet in the area of the Cross Ledge. These differences in behaviour of two offshore banks which appear, superficially at least, to be closely comparable reflects variations in local conditions. In Sandwich Bay the projection of the Isle of Thanet and the configuration of the French coast means that the direction of approach of the dominant wave is from the north-east. This direction coincides with the path of the ebb stream residual moving in a south-easterly direction in the channel of the Gull Stream. In this situation, with waves and tidal streams acting in harmony, one reinforcing the other, the net transfer of bottom sediment is towards the shore. The sand waves developed on the surface of the Brake Bank show this to be the case. The lateral migration of the bank towards the shore is further helped by the anticlockwise rotation of the Goodwin Sands with which it is intimately related (Cloet, 1954). In Start Bay, in contrast, the directions taken by the dominant tidal streams and dominant waves are at right angles and, as all the available evidence points to the former being responsible for transporting bottom sediment, the movement of the Skerries Bank is parallel to the coast. In Start Bay also the maximum velocities of the ebb and flood tidal streams are less, so that little sediment is brought into the area from adjacent parts of the English Channel. This comparison of the Skerries and Brake Banks serves to emphasize the individuality which characterizes these submarine banks and confirms the view that when dealing with the complex problems of shallow water morphology any broad generalizations can be erroneous and misleading.

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BOUNDARIES OF THE AGREEMENT AREA OF THE IRANIAN OIL CONSORTIUM DETERMINED BY TELLUROMETER AND HELICOPTER

H. SOMMER

An abridged translation from French of an address delivered by Ing. H. Sommer, then chief surveyor of the Iranian Oil Exploration and Producing Company, to the Iranian Association of Engineers at Teheran on 18 January 1960.

AN IMPORTANT SURVEY to determine some of the "Agreement Area" boundaries ended on 8 November 1959. The words "Agreement Area" include the area mentioned in the 1954 Agreement between the Government of Iran and the National

Fig. 1. Agreement area of the Iranian Oil Consortion

Iranian Oil Company on the one hand and the Oil Consortium on the other. This geodetic work was carried out in a remarkably short space of time. In less than five months we measured a geodetic traverse starting from a point on the Iraqi–Iranian frontier, climbing northwards to Kermānshāh, cutting through the highest summits

of the Zagros Mountains to arrive finally at a point some 150 km. to the south-east of Bandar 'Abbās (see Fig. 1). We were able to carry out this work, unique of its kind in the world, for two reasons only: we had at our disposal the most modern equipment and means of transport, and all the different groups making up the team showed a perfect and complete spirit of cooperation.

Consideration was first given to this problem of determination of boundaries towards the end of 1957. The Agreement Area for exploration and exploitation of oil by the Consortium measures some 270,000 sq. km. The boundaries are of three completely different kinds, and their recognition and determination constitute completely different kinds of problems.

1. The western boundary coincides with the Iran/Iraq political frontier; it begins at the mouth of the Shatt-el-Arab and runs north-westwards.
2. At the point where the 46th meridian cuts the frontier, the boundary veers north and then south-east until it is south of Bandar 'Abbās. This boundary is clearly defined by nineteen points known by their geographical coordinates. These nineteen points are joined together by straight lines.
3. To the south of Bandar 'Abbās the boundary leaves land and goes out to sea. It is defined along the coast by a line 3 statute miles out, that is 4·8 km. to sea from the lowest tide line.

The following decisions were taken at the end of 1957 after several useful discussions between the National Iranian Oil Company and the Consortium.

(*a*) The land and sea boundaries in the Persian Gulf—excluding the Iraq/Iran frontier—should be established and defined more specifically. Up to the present, boundaries had been taken from somewhat doubtful maps according to the 1954 Agreement.
(*b*) The Consortium was given the task of studying this project, organizing and controlling operations.
(*c*) Both the Iranian Government and the National Iranian Oil Company on the one hand and the Consortium on the other appointed Dr. F. Kobold, professor at the Polytechnique at Zürich, as a neutral adviser and expert.
(*d*) The National Iranian Oil Company asked the National Cartographic Centre of Iran to supervise the over-all technical side.

I am concerned here mainly with describing the actual work of delimiting and determining with exactitude the land boundaries of the Agreement Area. But before broaching the subject proper, I should like to say a few words about subsequent work to determine the seaward boundaries in the Persian Gulf. The establishing of the lowest tide line and of the line situated 3 statute miles out to sea was carried out as follows.

We installed several tide-gauges all along the coast, some of which were in use for more than a year. After a preliminary study of these gauges, a plan for taking aerial photographs was conceived and carried out. Three consecutive flights were undertaken at about two hourly intervals, beginning at low tide. We then had three photographs showing a varying water-line. We also had the information given by the gauges at the time of each flight. With this information—the water-line given horizontally in the photographs and vertically on the tide-gauge readings—and assuming that the coast is uniformly sloped, by extrapolation we can determine the line of the lowest tide. After deciding on the lowest tide on the photographs, the chosen photograph will be drawn to a scale of 1:50,000 and the 3 statute miles established.

Aerial photographic survey work in the Persian Gulf is finished, covering more than 6000 km., and using the RC 5A Wild camera, which has a focal length of 15 cm. We took some 1800 photographs each 22 cm. square. The 200 or so control points along the coast were based on triangulation work. Independent photogeological experts are interpreting the photographs of the various water-lines, appointed by the National Iranian Oil Company and by the Consortium respectively.

We now come to the part of the survey which was concerned with identifying land boundaries and was carried out in the summer of 1959. These boundaries are defined, as stated above, by a series of points joined together by straight lines. These nineteen points are clearly defined by their geographical coordinates. They have to be fixed on the land or on an accurate map. By setting up definite points along the boundary near the point of intersection, it is very easy to determine, if needs be, the physical spot. But to identify this boundary to, say, within 10 or 20 metres a 1:50,000 map should suffice. To draw this map, it was decided to carry out three parallel aerial photographic flights along the boundary and then to restitute the photograph to the scale required. Here too we required control points to carry out an aero triangulation and a correct restitution.

To obtain coordinates that would be accepted as official, we had to connect our fixed points to the primary triangulation of Iran, a chain which joins Turkish to Pakistani triangulation, and which follows the Agreement Area boundary on a more or less parallel line at a distance of about 150 to 200 km. Several methods of determining these fixed points were studied. We finally chose the method of geodetic traverses, taking into account recent improvements in the ways of measuring direct distances with electronic apparatus and transport by helicopters with a high operational ceiling. Angles were established with an accurate theodolite and distances with a tellurometer.

I would now like to touch on the great improvements achieved in recent years in the field of direct and precise measuring of long distances. In about 1951, the Swedish Professor Bergstrand perfected an apparatus based on the speed of light. This apparatus, called a geodimeter, measures the time taken by a strong modulated light projected from a point A and reflected back to its point of origin by a mirror placed at point B. If all precautions are taken, this apparatus can give extremely accurate results. Many geodetic bases and triangulation levels have been measured by geodimeter. In Iran the Army Geographical Service assisted by the American Map Service measured several bases of the triangulation system by geodimeter. To give you some idea of the accuracy of these time measurements you must solve a simple calculation: the speed of light is approximately 300,000 km/sec, or 300 million metres/sec. To obtain an error of less than one metre for any given distance, time must be accurate to within $\frac{1}{300}$ millionth of a second. With a geodimeter, distances are measured to within a few centimetres. The geodimeter has disadvantages, however, in that it can only be used at night and is comparatively heavy, though various improvements have been incorporated into recent models and less heavy ones made.

A few years after the invention of the geodimeter, in about 1956, a new electronic apparatus for measuring distances with great accuracy was built in South Africa. Mr. Wadley developed a system called the tellurometer, made up of two parts, the transmitter or "Master" and the receiver or "Remote". The tellurometer works with wireless waves of about 10 cm., that is, with micro-waves. A modulated wireless wave is continuously put out; this wave reaches the Remote station, is retransmitted to the Master station and then is compared with the primary wave, and the difference of phase is noted. Readings on the instrument are taken at a millimicro-second in time—that is, within 15 cm. These measurements can be taken by day or night, in cloudy weather or in slight rain. The apparatus with all accessories, batteries, stand, etc., weighs about 32 kg. The "Master" and the "Remote" are very similar in appearance, but are not interchangeable. A new model, which may not be generally available yet, has been built by the same concern, where the two parts are interchangeable and each can emit and measure the distance between two points.

Exact measurements are greatly dependent on suitable meteorological conditions. Fortunately, however, in Iran these conditions are often fulfilled—dry, sunny weather is ideal. At both stations barometer readings, temperature and humidity are registered. Reflection of waves on the ground can reduce accuracy, but by an ingenious method of observation this trouble has been almost eliminated. I shall not enter here into details of this technique which really belongs to the field of physics and electronics.

Within the tellurometer itself, a wireless telephone Duplex has been built. This is

primarily to communicate electronic and meteorological observations from the "Remote" to the "Master", but it can also be used as a means of communication between the various groups of topographers. It also enables one to observe reciprocal vertical angles simultaneously. Therefore the determination trigonometrically of height differences is more accurate. Errors due to refraction are practically eliminated.

After this brief description of electronic measurement of distances, I return to my main topic—the delimiting of the land boundaries of the Agreement Area. These pass through the mountains of the Zagros chain, and cross almost inaccessible regions. A geodetic traverse had to be placed along the line, at specific points that varied from 10 to 65 kilometres apart. The main problem was to find an efficient and economical means of transport. It was only possible to place operators and equipment quickly at observation posts—say within one or two hours—by using helicopters between the camp and the observation posts. A comparison was made between the time that it would take helicopters to do the work, and the same programme using the ordinary means of transport—in this case, mules. The comparative figures were: *with helicopters*: four to five months, with a strong team of surveyors; *without helicopters*: about five years, with two strong teams of surveyors working five to six months a year. These two teams, with their equipment, would have cost twice as much and the fact that work would have been spread over several years would also have greatly influenced over-all uniformity. It was unanimously decided to use helicopters.

Preliminary work began with a two-day reconnaissance flight along the boundary line in March 1958. Two helicopter pilots, Dr. Kobold of Zürich, Mr. Ebrahimi (Director of the National Cartographic Centre of Iran) and myself were in the party. Based on this flight and on all the information available, a first tentative plan was drawn up, and in May and June of the same year a three weeks' reconnaissance trip in a Land-Rover was undertaken. The final position for the camps was fixed, as near as possible to the boundary. The problem of drinking-water, food supplies and all other essential matters for such a large-scale operation in such isolated places, were carefully studied. Land work had to be concentrated between June and November because of the altitude of the observation posts—40 per cent being over 2500 metres high, 15 per cent between 2800 and 3800 metres; all these are covered in snow during six months of the year.

A detailed study of the project enabled us to set out the following plan which was fulfilled almost exactly.

General organization.—I was in charge of this and had the following staff: 1 party manager who was a qualified surveyor; 5 surveyors; 1 electronics-engineer; 1 camp supervisor responsible for liaison with local civilian and military authorities; 3 or 4 helicopter pilots; 1 engineer to maintain wireless communications.

Organization of camps.—Two completely autonomous camps were to be set up. This had the great advantage that when work based on Camp A was finished, Camp B (some 120 km. away) was already installed and it was only a matter of a few hours to transfer essential staff and delicate instruments by helicopter; normal work was not disrupted. In each camp there was a total of thirty men, to act as drivers, cooks, servants, police and labourers. This rather special organization, adapted to the work output, proved satisfactory. In all, fifteen camp sites were found and thirteen camps set up. For a few days the two oil-fields of Masjed-e-Soleymān and Gach Sārān were also used as secondary camps. Each camp had at its disposal five 3-ton lorries, one bulk fuel lorry, three Land-Rovers with 4-wheel drive and 35 tents. More than 70 per cent of the food was brought in by plane and the rest by lorries; landing fields at Kermānshāh, Esfahān, Shirāz and Bandar 'Abbās were used. Every fortnight a DC3 aircraft was placed at our disposal. The main supply base was Masjed-e-Soleymān.

Organization and carrying out of geodetic work.—Three helicopters (Bell 47 J) were placed at the disposal of the topographers; a fourth, of the Alouette 2 type, which can reach higher altitudes, was added two months after work had begun. Thanks to this modern and efficient transport, the surveyors were able to work remarkably quickly under almost ideal conditions. Hitherto, in similar situations, a surveyor

lost up to 90 per cent of his time getting to the spot; now he can reach his destination with no trouble by helicopter. Physically fit, all his energy can be directed towards his work. The helicopter landed nearly always near the station to be occupied and no surveyor had more than a quarter of an hour's walk. The best times could therefore be chosen for making observations, and the simultaneous occupation of two stations (an essential for use of the tellurometer) was always possible within two hours. Without the helicopter, this could have taken days or even weeks.

Work on the main project began on 14 June 1959 to the south of Kermānshāh, near the Iraq frontier; on October 31 a geodetic traverse of over 2750 km. was finished. On November 6 the last of the 350 control points for aerial photography was lifted and on November 8 work ended on the last of the eight astronomical observation posts. These observations determine the bearings that orientate the geodetic traverse. In less than five months the operations were complete.

Appendix

A few facts and figures may be of interest. Operations were carried out with the help of at least two and sometimes three helicopters. The other planes were either at the camp, ready for use if required, or being serviced or repaired. On a mountain top near Shirāz there was an accident which might have had serious consequences. The direction of the wind veered suddenly as a helicopter was landing, the small rotor at the back touched and broke. Fortunately, no one was hurt, but the machine had to be flown by plane from Shirāz back to the base at Agha Jari.

Twice work stopped for some six to eight days, since only one helicopter was available and it was considered wiser not to work with one only. Operations on land were carried out over a period of 147 days, with only twenty-five days' break, or 17 per cent of the time. The main causes for stoppage of work were when only one helicopter, or no helicopter, was available, and when sandstorms or gales prevented flying. Three days of bad weather in September in the Bandar 'Abbās region interrupted work, as did the transfer from Bandar 'Abbās to Masjed-e-Soleymān early in October, when three of the four helicopters flew some 1100 km. in one day—a new world record, according to the contractor.

Camps were placed as high as possible, most of them to the north of the Zagros Mountains or in valleys near mountains. Mostly they were situated between 1500 and 2500 metres. Here are the average altitudes of the traverse stations:

Camp 1	1850 m.	Camp 8	3000 m.
Camp 2	2100 m.	Camp 9	2600 m.
Camp 3	2500 m.	Camp 10	2650 m.
Camp 4	2650 m.	Camp 11	2700 m.
Camp 4a	3100 m.	Camp 13	2250 m.
Camp 5	3150 m.	Camp 14	500 m.
Camp 6	2900 m.		

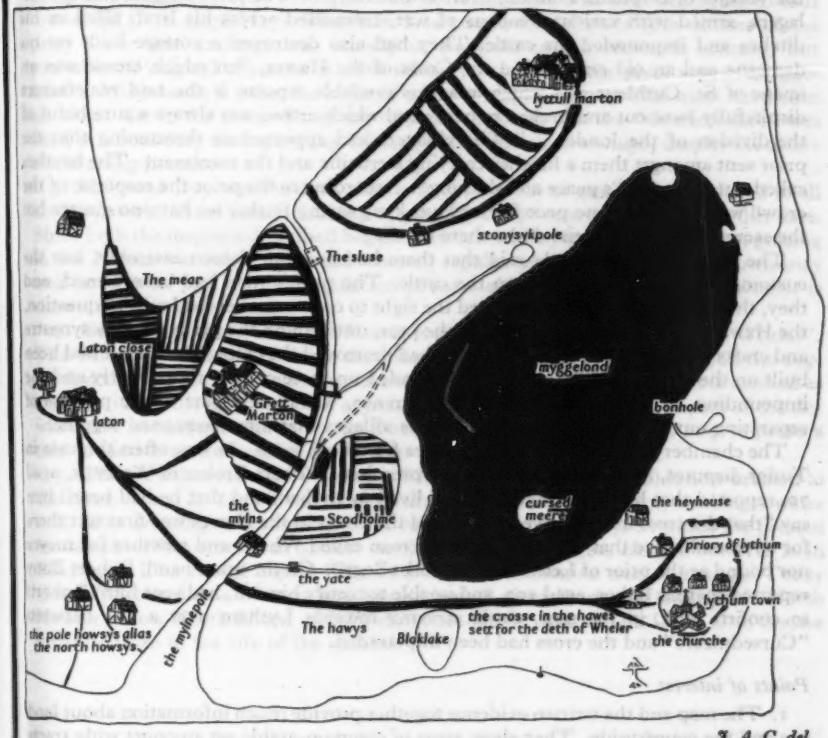
Snow began to fall on October 27 on a summit of 3650 m., and by ill luck (and for the first time) two surveyors had to spend a night at this altitude. Unfortunately no helicopter could be used for two consecutive days. Two people for rescue were brought from the camp with difficulty to 2200 m. on the second day, but an oil leak prevented further use of the helicopter. The two groups managed to join up and thanks to the food and sleeping bags which it had been possible to take to them, the two subsequent nights spent out of doors were bearable.

BLACKPOOL, A.D. 1533

E. M. YATES

LIKE THE ASHBOURNE MAP published in the December 1960 *Journal* this early map of the south-west Fylde (M.R.1) was prepared as part of the evidence in a dispute heard in the Chamber of the Duchy of Lancaster. The dispute was long drawn out, over the period 1531–3. (D.L.1/8/P3, D.L.3/22/L1 and L2.)

The map.—The map measures 36 inches by 35 inches and represents an area of



J. A. C. del.

Map of the south-west Fylde, redrawn from unpublished Crown copyright material in the Public Record Office. Reproduced by permission of the Controller, Her Majesty's Stationery Office

approximately 6 miles by 3 miles, including one large moss and part of Marton Mere. No scale is given on the map. The villages are not exactly placed, and although most of the features shown can be identified, the accuracy is not as high as that of the Ashbourne map. No orientation is given, but the Fylde coast, here running north–south, is at the bottom. The map is coloured naturalistically, with blue water, brown and black ploughed fields, black moss and red roofs.

A number of mistakes or alterations are visible. Firstly, the house above "Priory of

Lythum" has been almost completely expunged, and is much clearer on the reproduction of the map than on the original. Secondly, the junction of the Stonysyk (syk = stream) with the mill stream from Marton Mere has been shifted east. The lower course of the Stonysyk first drawn is still visible and is here shown dotted. Some type of sluice was probably drawn at the old junction and the alteration has left a confused patch between "Grett Marton" and "Studholme" across the mill stream. This type of error suggests that the map was based on field sketching. Thirdly, the south-east quarter of Laton close, originally drawn as plough-land, has been covered with green paint, although the plough-land symbol can still be clearly seen. It is shown as plough-land on the reproduction. Finally, some place-names were omitted on the original from the cartouches prepared for them.

The dispute.—The dispute was between the prior of Lytham and the inhabitants of the villages of Bispham, Poulton, Marton and Layton. The prior alleged that the villagers, armed with various weapons of war, trespassed across his land, filled in his ditches and impounded his cattle. They had also destroyed a cottage built on his demesne and an old cross called the Cross of the Hawes, "on which crosse was an image of St. Cuthbert and which image as credable reporte is the said malefactors dispitefully have cut and broken to peces and which crosse was always a sure bond of the division of the londe . . ." The villagers had appeared so threatening that the prior sent amongst them a brother carrying a crucifix and the sacrament. The brother called out "For God's peace and the king". According to the prior the response of the crowd was "they kepe no pece for lord nor kyng saying ferther we have no master but the sacrement that the prist dothe there bere".

The accused in their reply said that there had been no riotous assembly, but the customary gathering to round up the cattle. The prior's men had been armed, and they, the villagers, had always enjoyed the right to common over the lands in question, the Hawes, for all cattle at all times of the year, until Ralph the prior "by hys synestre and crafty meanes hath enclosed". They had destroyed the cottage because it had been built on the common. The cattle were rounded up three or four times yearly and the impounding, to which the prior made reference, was merely part of the process of separating out the animals from the various villages that intercommoned together.

The chamber judges then heard witnesses from both sides. As was often the case in Tudor disputes, long memories were at a premium. Robert Croker of Warbeck, aged 70, reported that his father, aged 94, had lived in Lytham and that he had heard him say "that the cross in the Hawes now called the Cross in the Hawes was first sett there for a remembrance that one fideler killed a man called Wheler and nawther for meyre nor bound as the prior of Lethom nowe doth allege". On the other hand, Robert Bony reported that his father, aged 100, and unable to testify himself, had sent him (Robert) to confirm that, in the past, cattle straying towards Lytham over a line between "Cursedmeere" and the cross had been impounded.

Points of interest

1. The map and the written evidence together provide much information about land use and the countryside. They show areas of common-arable set amongst wide tracts of pasture. Timber framed buildings, water and wind mills, gallows and sluices help to complete the picture of a sixteenth century landscape. The arable and the villages were sited on the low clay mounds, whilst the pasture extended over the moss and the coastal sands. The dry mounds were probably originally islands in a maze of meres and mosses. Indeed the "holm" in Stodholme probably means "island". The pasture rights were obviously very important to give rise to such high feelings, and the number of cattle involved appears to have been large. The prior complained that 154 of his beasts were impounded. Another intercommoning dispute occurred in 1547 involving the villagers of Little Marton and those of Great Layton (D.L.3/46/B5) and in the course of the hearing the number of cattle from Little Marton that used the common was given as sixty. In this later trouble the place of prior as the accuser was taken by a John Browne of London. The latter was a new landowner whose land lay to the north-

west of the common, and another aspect of the dispute was the crossing of Browne's land by the cattle of Little Marton on their way to the common. Mr. Browne therefore looks to be one of the class of "new men", the landowners of Tudor times associated with the enclosure movement of that period.

The place name "Laton close" written over plough-land is most curious. It may refer either to the intake and improvement of pasture land or to the enclosure of former common arable land. Since in the sixteenth century the latter process was often accompanied by a reversion to grass this may be the explanation for the painting-out of the plough-land symbol already described.

2. The moss played an important role in the life of the district. Apart from the grazing it provided turf for fuel and reeds for thatch. Both of these usages are mentioned in the disputes described. It also provided sport, for yet a further dispute in Elizabeth's reign involved the right to hawk in the moss over land belonging to four townships (D.L.1/136/H17). The moss is of course now drained (the ditches of the prior show that drainage was already in progress in the sixteenth century) but probably its original character is most tellingly recalled by the place name "Myggelond". Midgelands is today the name of a farmstead, occupying what must have been an island site in the moss. From the dispute it appears that the "Cursedmeere" was used as a boundary distinguishing the land of the various townships, despite the intercommoning practice.

3. Holyrood Day was the date when many commons of grazing were opened to all kinds of stock. From some commons of grazing, sheep were excluded before this date. Since both the disputes described began on Holyrood Day it would appear that grazing in the Hawes was subject to some seasonal regulation. The yate or gate shown may well have been part of this regulation process although, presumably in error, it is shown across a water course.

4. On the map the cross in the Hawes is marked as "sett for the death of Wheler". The defence in the case between the prior and the villagers depended upon the suggestion that the cross was a memorial and not a boundary mark. Since it is marked as a memorial on the map, it would appear that the map was prepared as part of the defence and not independently by the Duchy authorities. This use of a map to prove a title to land is an interesting innovation.

5. The shrunken remnant of Marton Mere (the mere on the map) is now drained to the river Wyre. In 1533 it was drained direct to the sea via a sluice, working a water mill. The draining of the mere and the moss are two of the ways in which the present landscape differs from that shown on the map. The biggest change however is in Blackpool. The coastal lagoon "Blaklake" had no habitation near it in 1533. Today Great Marton, Little Marton and Layton are all virtually part of Blackpool. North Houses is now North Shore, and the club house of St. Anne's Old Links Golf Course must be close to the site of the gallows.

THE *GEOGRAPHICAL JOURNAL*: NOTES FOR CONTRIBUTORS

IN FUTURE, intending contributors to the *Journal* will receive a leaflet containing rules of style and setting. The text of this is printed below, and copies may be obtained from the Assistant Editor.

The following is the practice of the *Geographical Journal* in regard to the preparation of manuscripts for publication. Without prior consultation with the Editor, contributions should not exceed a maximum of 5000 words, including references. Owing to pressure on space, contributors are advised to keep their papers as short as possible, as the Publications Committee must take length into consideration.

I. THE TEXT

The text should be as short as possible, consistent with an adequate presentation of the evidence and an accurate statement of the author's views. Attention must be given to the paragraphing of the paper; while an excessive number of paragraphs should be avoided, it is essential that consecutive stages in the development of an argument should be expressed logically in a succession of paragraphs.

Unless there is a cogent reason, sub-headings should not be introduced. Long, complicated sentences are confusing, and technical terms, not generally accepted, should be introduced only where absolutely necessary and with adequate explanation. The aim should be to write, in Sir Halford Mackinder's phrase, "a good plain English sentence". The use of "jargon", in the mistaken belief that it gives the paper a "scientific" character, should be avoided. Many papers submitted for consideration for publication could be considerably reduced, without loss of intrinsic value, by cutting out unnecessary words and phrases.

In the case of reviews, contributors should consult earlier copies of the *Journal* and head the notice to correspond.

These suggestions on style are submitted in the interests of the author, the reader and, not least, of the editorial staff. Their observance will result in appreciable economies in printing costs.

II. PREPARATION OF TYPESCRIPT

The paper must be typed, double spacing with ample margins, preferably on quarto paper and on one side of the paper only. A carbon copy is desirable. The paper must be complete when submitted, and the pages numbered consecutively.

III. FOOTNOTES AND REFERENCES

Footnotes should be kept to a minimum. In most instances, their content can conveniently be embodied in the text. The practice of the *Geographical Journal* is to place bibliographical references at the end of a paper, partly for reasons of economy in printing. In line with the practice adopted by the Royal Society (*Notes on the preparation of papers, 1951*) "references to the literature cited must be given in alphabetical order at the end of the paper". They should take the following form: *In the text*, author's name and date of work, e.g. (Carse, 1959), (Armstrong, 1958); *In the reference list at end of paper*, name and initials of the author, year of publication, title, short title of the periodical as given in the *World list of scientific periodicals*, volume in heavy Arabic numerals. Place of publication other than London should be given; name of publisher only when useful in tracing the book

(i.e., publishers of old books who no longer exist need not be stated). The titles of books will be set in italic, of periodical articles in Roman. The title of books in the typescript should therefore be underlined. Thus:

Periodical

Carse, D. 1959 The survey of South Georgia, 1951–7. *Geogr. J.* **125**, 20–37.

Books

Armstrong, T. E. 1958 *The Russians in the Arctic.* Methuen.

Sømme, Axel (editor) 1960 *A geography of Norden.* Oslo: J. W. Cappelens.

IV. SKETCH MAPS AND DIAGRAMS

These will be re-lettered and if necessary redrawn in the style of the *Geographical Journal* by the Society's draughtsmen. They should be prepared for a 3 to 2 or 2 to 1 reduction. The dimensions of a *Journal* page are $7^1_2 \times 4^3_4$ inches. Sketch-maps are expensive to draw and to reproduce, and where possible contributors should design each map to demonstrate as many points as possible compatible with clarity.

V. ILLUSTRATIONS

Photographs, no matter how necessary they may be to illustrate the text, cannot be accepted for publication unless they are of a suitably high standard. The quality of the photographs submitted with many papers is often too poor to justify the considerable expense of block making.

The final decision regarding photographs to be reproduced rests with the Editor. The usual amount of illustration possible is a maximum of six photographs. Up to twelve prints, black and white, glossy finish, from which the selection will be made, should accompany the paper. All prints must have full titles on the reverse, and will be returned. Copyright of photographs should be cleared with the holders before they are sent to the Editor.

VI. PROOFS

Authors of papers accepted for publication will receive *page proofs only*. These should be carefully corrected and returned, with the least possible delay, to the Editor. No subsequent correction can be made.

ONE HUNDRED YEARS AGO

THE FOLLOWING extract is taken from "Boat excursion from Bangkok, in Siam, to the Pechaburri, on the Western Shore of the Gulf of Siam," read to the Society on 11 June 1860 by Sir Robert H. Schomburgk, Corr. F.R.G.S. Printed in the *Journal of the Royal Geographical Society*, **30** (1861) 302–21.

". . . The tide having sufficiently risen, we continued, and entered with daylight a broad watercourse, equal in breadth to the Menam. It was a pretty sight when, on our escape out of the small canal, we entered the Thatchin, as this canal is called, bordered by bushes above which fan-leaved palms were towering, the banks studded with houses, the canal enlivened by numerous boats, in size from the small skiff to the unwieldy barge, carrying the produce and merchandize from the interior provinces to the capital. The barometer stood then 30·20 inches, the temperature of the atmosphere was 78° Fah., and that of the water 88° Fah.; showing the same difference at that early hour in the morning as under the tropics in the west. At six o'clock we arrived at a place where the canal divides into two branches: the one takes a direction to the north, the other to the west by south.

At the fork where the two canals divide, and likewise on the opposite banks, were a number of houses, perhaps from 150 to 200, with here and there a Chinese shop amongst them. The open spaces before the houses were heaped up with firewood for the market in Bangkok. This is the village Thatchin, bearing the name of the canal.

Our appearance caused some stir. Above the token of Siamese nobility the white ensign—Great Britain's prettiest colours—was flying in the Kalahome's boat, while the flag of Hamburg was waving from the stern of the boat in which were my companions. My Cochin-Chinese boat's crew sung one of their liveliest ditties, stamping their feet with extra vigour, and the boatmen in the Hamburg consul's boat set up in opposition one of their Siamese songs. The dogs in the village did their utmost to welcome us by loud barking, and here and there out of the small windows of the huts peeped the face of an astonished inmate, rubbing the sleep out of his eyes in order to stare at us. This did not give me the idea of a propensity, on the part of the Thatchin people, to rise early, for it was then already past six o'clock.

The canal which was to carry us to Meklong becomes now narrower, and takes a south-western direction. We halted for an hour at the wat Kuthia; while breakfast was being prepared we took a stroll.

Along the banks of the canal were a number of huts of mean construction, and, from appearance, untidy within, the inhabitants of which rushed out of their habitations when the furious barking of the dogs announced to them that there was something more uncommon to be seen than an everyday's occurrence. The little children playing before the huts ran frightened away, screaming lustily, just as I had previously witnessed it in the Indian villages in Guiana, when persons white of colour presented themselves and I am sure had there been any parrots in the huts they would have done their utmost to outdo the children in screaming, just as in Guiana.

I was struck with the great difference in the appearance of the women at this village when compared with the generality of the Siamese females. They were much fairer, and, in lieu of the short tuft on the crown of the head, they possessed long flowing black hair. Some had it neatly plaited, in the manner European ladies used to wear it in the commencement of the present century. I was told they were Muangs, or Peguans, from the Burmese boundary; but why there should be such a number in this locality, the generality so much superior in appearance to the Siamese women, while their husbands had the looks of the common male creation of Siam, I did not learn.

Fighting our way through the assailing dogs, we continued our walk along the raised pathway that traversed the marshy plains, covered with a vegetation of saline plants, by no means of great interest to a botanist who finds the same feature represented under similar latitudes where the soil favours that class. However, I noticed a Solanum climbing up the trees and bushes of mangrove, the flowers of which were of a fine blue, in various tints, as the light fell upon it. The people, when they saw that I gathered it, came to the conclusion that I must be a medicine-man, and told me that they used a decoction of it as a purgative.

The train of men and children that followed us increased as we went along: the urchins took confidence on seeing others following us, but the women satisfied themselves with a stealthy glance through the little square windows of their houses; or, where it happened that they were outside of their huts, they stealthily turned the head over the right or left of their shoulders, retiring with precipitation to their habitation. I was forcibly reminded how frequently I had witnessed similar instances during my peregrinations amongst the Indians in Guiana, thus adding a new confirmation to the doctrine that unsophisticated nature is so frequently the same.

The crowd followed us to the wat. To judge from the scanty and worn-out clothing of the few talapoins which we saw there, and the small number of dwellings, it must have been a temple of but a moderate income. The priests watched our proceedings at breakfast with great curiosity, but declined to accept partaking of any of the dishes sent to them. The grounds around the wat were neatly laid out, and were kept in good order."

BRITAIN'S ROLE IN PACIFIC HISTORY

BRITAIN IN THE PACIFIC ISLANDS. By W. P. MORRELL. *Oxford: Clarendon Press*, 1960. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 454 pages; maps, index.* 55*s*

PACIFIC HISTORY is very difficult to write. The best works of synthesis suffer from defects so obvious that one is led to consider whether the geographical and human complex that is New Guinea—Papua, Melanesia, Micronesia and Polynesia, may not contain too many disparities for its history to be forced into a single narrative. There have been some notable attempts. W. H. R. Rivers (1914) and Sir Peter Buck (1949) have, from different standpoints, offered comprehensive theories (or prehistories) of the first stages of aboriginal settlement—theories subsequently modified or challenged by C. E. Fox (1924) and, more controversially, by Heyerdahl (1953) and C. A. Sharp (1957). But such studies await the archaeologist, whose work in the Pacific has hardly begun. Without such basic information the anthropologist and historian are groping in the dark, as the early navigators in that great expanse of sea. No Cook has yet charted for us the tides and eddies of cultural distribution in the Pacific. For the period of discovery and settlement the important books are by Dr. G. H. Scholefield (1919), whose study embraces the borderlands of the Pacific as well as the islands, Dr. J. I. Brooks (1941), whose work on international rivalries is less of an *œuvre à thèse* than its title suggests and does not extend beyond 1875, Professor J. M. Ward (1950), who postulates in his book on British policy a consistently negative frame of mind for British statesmen and officials who considered Pacific questions, and, finally, L. A. Mander (1954) whose book on Pacific peoples (including the Australian Aborigines) is a survey of more recent events and lacks an historical background to explain the differences and similarities between the administrative policies discussed.

Somehow all these contrive wholly or partially to miss the point, or rather two points: what are the limits of the Pacific as a subject for historical analysis; and what were the processes of European contact and the response of indigenous societies in the defined area? Professor W. P. Morrell, in answer to the first question, rightly suggests that "the proper subject of history is not an area but a community". But which community? If Polynesia is included as a segment of the Pacific "community", it is difficult to see why New Zealand or the Hawaiian Islands after the 1840's have been excluded from this study. The first, it is claimed, "though set squarely in the South Pacific, has had a history of marked individuality since the islands became a British colony" (p. 1). But surely for the first half of the nineteenth century the New Zealand trading ports, settlements, and brown and white population resembled the communities of Honolulu, Papeete, Suva and Apia; and, until the advent of responsible government, the differences were of degree rather than kind. The case for the inclusion of Hawaii is even stronger. The fact that American and not British influence was eventually paramount there does not alter its essential historical unity with other parts of Polynesia. Nevertheless, "community" for the purpose of this study is defined in a very special way: "the advent of a Power which was mistress of the sea and hence the means of communication between the island groups gave the history of the Pacific Islands a unity it never previously had". Such a narrow premise weakens the conceptual framework of the book (just how was island history more "united", except in the sense that much of it was recorded in English?).

The special strength of this work lies in its attention to detail and in the rejection of the narrow nationalistic approach where the narrative demands it. British missionaries, traders, planters and naval officers, allied or in conflict with indigenous authorities and other European agents, determined the state of affairs that brought about British annexation or protection over a sizeable part of the island world. But European contact was international; and if the French and German share of partition was ultimately smaller than that of Great Britain, Australia and New Zealand, nevertheless

their traders, planters and missionaries (together with those of the United States) make the sources for nineteenth century Pacific history scattered and trilingual. To some extent this is recognized, before the acquisition of British colonies deflects the narrative to a consideration of the policies and practice of British administration, till about the end of the century. The sources for this approach are secondary works (including a good spread of French and German studies), British primary published material, and some reference to the Colonial Office and Foreign Office files to clear up doubtful points. The range of reading is impressive and the discrimination with which the records are used, accurate and scholarly. One misses a bibliography to pull the references together.

The first five chapters—about a third of the book—are devoted to the work of the L.M.S., Wesleyan and Presbyterian missionaries in the Society Islands, the Cook Islands, Tonga, Samoa, the New Hebrides, New Caledonia, the Loyalty group and to Selwyn's Melanesian Mission in the Solomons. There were some notable examples, like Bishop Patteson, of "the power of an educated mind controlling while following the native taste" (*cit.* p. 114). And, on the whole, the missions were well established both as teaching institutions and pioneers in island administration, before their position was challenged by white traders and settlers and by native authorities with other alien supporters. This is the only thorough study of the missionary "kingdoms" (Hawaii and Catholic experiments apart) that is neither apologetic nor superficial and it is by far the best account of the pattern of mass conversion in Polynesia. It is a little over-kind perhaps to the L.M.S. in Tahiti and to the missionary codes of laws: though there were harsh penalties for breaking sanctions in Polynesian society, the responsibility for writing capital punishment and banishment into the 1819 Code must lie with the missionaries (p. 43).

The advent of French naval officers to protect the interests of a few nationals and Catholic missionaries is treated as the principal obstacle to British hegemony in eastern Polynesia. The reasons for Admiral Du Petit-Thouars' visit to Tahiti in 1842 (the French had no official designs on the group) are not mentioned; it was not through fear of British intervention, but simply, according to orders, for the purpose of settling a dispute between the French Consul and the Catholic mission. There was no petition for French protection in 1841, as stated (p. 77)—merely a request for assistance from French officers in a particular case of law-enforcement. The addition of Queen Pomare's signature to the real petition the following year was not "out of sheer lightmindedness", as suggested, but almost certainly on the advice and insistence of two British subjects, Salmon and Simpson (one of whom was a missionary). The Pritchard affair is treated in full—perhaps in more detail than it deserves, since it was of little importance for the political fate of the Society Islands which had already been decided, as far as Tahiti was concerned. Less well-known is the early penetration of Melanesia by missionaries and sandalwood traders. The reception of the former was greatly influenced by the conduct of the latter—as exampled by the murder of John Williams at Erromanga and the opposition to Paton on Tanna. Some of the myths concerning Franco-British rivalry for New Caledonia are disposed of; but reference to the work of Pastor R. H. Leenhardt on the Loyalty group might have helped to clarify the reasons for the trouble between the turbulent McFarlane and the French administration at Noumea.

Chapter six introduces the reader to the first British colony in the Pacific outside New Zealand and outlines the gradual breakdown of experiments in island government that preceded the annexation of Fiji. There is an excellent section on Fijian reaction to the missionaries, on the important political relationship between Thakombau and King George of Tonga, and on the influential role of Tongans in Fiji. A full explanation is given for the slow movement of the British Government towards acceptance of the offer of cession in 1874, to put an end to a state of affairs "bordering on anarchy" (*cit.* p. 164).

There follows a chapter which draws together the threads of the Pacific islands labour traffic, the work of its opponents and the Western Pacific Order in Council—the first

far-reaching piece of legislation for the islands since the establishment of New South Wales. The Order was remarkable, however, for its limitations—the High Commissioner had no real jurisdiction over foreigners or natives outside Fiji—and for its endeavour to make the new Crown Colony "a centre from which law and order might be diffused throughout the unannexed islands of the Pacific" (p. 185). This legislation prefaces a further five chapters on the partition of the Pacific; for, in a sense, it epitomized the failure of courts (whether native, missionary or *ad hoc* Commissioner's courts) to settle problems of lawlessness without the executive authority which Britain, France and Germany were called on to supply. The plight of the L.M.S. under French rule, curiously enough, is touched on; but there was a "British withdrawal" from eastern Polynesia only in this sense of missionary defeat. Indeed, there was nothing else to withdraw, except traders' capital which, so far from leaving, brought in profitable returns to the British settlers who stayed or came later. On the other hand, Australian commercial and evangelical interests had some reason to fear for their position in the New Hebrides, but were too firmly rooted to be moved without a struggle. The resulting compromise was the Mixed Naval Commission of 1887 and, when this failed and trade and plantations expanded, the Condominium of 1906 (established despite the Australian Premier's proposals). How the Condominium worked before 1914 is not described, apart from a short reference to health problems. The partition of Samoa is fully treated and, with help from German works, the role of the firm of J. C. Godeffroy and Son is contrasted with American and British concerns in their bid for a voice in native government. Unlike Fiji, the result was the Tripartite settlement and German annexation. The Pacific had changed: by the last quarter of the century the trading companies were playing the part performed earlier by missionaries and small commission agents; and, as in Hawaii in the 1880's, the stakes were plantations, not the right to catechize. The last relics of the missionary kingdoms were the Tonga group and, to a lesser extent, the Cook Islands. The first illustrated how impossible it was to leave island government in the hands of even a phenomenal missionary administrator like Shirley Baker aided by that excellent patriarch, George Tupou; the second illustrated the difficulty of making any government of chiefs work, without a central authority. The solution for Tonga was the removal of Baker in 1890 and the establishment of what amounted to a protectorate under Fiji. For the Cooks, after the reforming Residency of Moss, responsible administration by New Zealand was determined on by Chamberlain and annexation made certain. The sections on the partition of Micronesia and New Guinea and the establishment of the Solomons protectorate are welcome for their detailed information. The spade-work done by the Melanesian Mission and the sheer difficulty of getting the Navy to cooperate with the High Commissioner in Fiji make the introduction of civil administrators in 1893 understandable.

Partition was partly the outcome of changes set in motion by alien intrusion into Pacific societies: "The control of its consequences was a problem of government, though not necessarily a soluble problem" (p. 361). The chapter on the administration of Fiji, based solidly on Parliamentary Papers, analyses the course and effects of British rule, concentrating on the work of Gordon, and stopping shortly after Thurston's death in 1897. All the classic problems of indirect rule were there, two decades before the principles to solve them were formulated in Africa. It had been perceived at an early date in Fiji that the most striking political result of European contact was not to weaken, but to strengthen, indigenous leaders in islands where "European land purchase and the supply of labour to European planters . . . tended to make the authority of the chiefs more oppressive to their tribes than in the past. Who could limit the authority of the chiefs, especially the greater chiefs? In theory perhaps Fiji might develop into a constitutional monarchy under Thakombau. But in practice this solution was unacceptable to Ma'afu and his following among the chiefs and unacceptable also to Europeans" (p. 167). The administration inherited this dilemma—that a measure of autonomy in native government entailed the possibility of overbearing paramountcy which could only be rectified by "direct" methods. The *Rokos*, as provincial chiefs,

were recognized, paid and given Fijian magistrates. After Gordon had crushed the "mountaineers", native provincial councils were adapted to the needs of local government administration and an annual council of chiefs encouraged (complete with *yanggona* drinking ceremony and Governor's speech). A new unity in Fiji was the result. But the *Rokos* and magistrates could be, and were, deposed and replaced when not up to imported standards. More debatable were the produce tax (defended in this study for its usefulness), the momentous decision to introduce Indian coolies, and to keep on introducing them, on the excuse that "pressure" might make the administration consent to "measures intended to coerce the native population of this Colony" (Gordon p. 382) and, finally, the settlement of land claims which entailed first the cavalier dismissal of most German purchases, and later compensation for them, extracted from the Treasury "by methods of blackmail" (p. 391). The early administration of New Guinea, run by Great Britain and paid for by Australia, was a very different affair. MacGregor's policy of personal government, here analysed with approval, had at least the merit of bringing in the law court after the patrol. Something, too, was done for European settlement, and much for the companies—with not altogether happy results.

Such is the scope of this study of British participation in the settlement of Pacific dependencies. In 1861 only the French were well established and, with the exception of the Condominium, had reached the limit of expansion. In that year, Colonel Smythe, sent to report on the offer of cession from Fiji, concluded: "judging from the present state of the Sandwich Islands and the former condition of Tahiti, it would seem that the resources of the Pacific Islands can best be developed, and the welfare of their inhabitants secured by a native government aided by the counsels of respectable Europeans" (*cit.* p. 137).

Nothing could have been further from the truth, as the next half century proved, not merely because "respectable" settlers were so few, but because the conditions of trade outgrew the capacities of such island governments to supervise them. On this point of trade and commerce, there is a lamentable lack of statistical evidence here to support Professor Morrell's belief in a "primacy of influence" for Great Britain in the Pacific (p. 63), particularly as some grudging admission is made of the share of the American whalers in opening up the islands to trade. It is questionable, too, how far Sydney was ever the "capital . . . of an ocean", in view of the dominating position of Valparaiso, and later San Francisco, and to a lesser extent Auckland and Canton, as markets for Pacific islands produce (p. 26). The study ends on an oddly plaintive and patriotic note, demanding continued United Kingdom participation in the responsibilities for an area whose defence and development have so obviously passed to other hands. But, this apart, the book will remain indispensable to scholars and students of Pacific history and of European expansion in general.

C. W. NEWBURY

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THE MAKING OF A NEW AFRICAN NATION

NIGERIAN PERSPECTIVES: an historical anthology. By THOMAS HODGKIN. *Oxford University Press*, 1960. $8\frac{3}{4} \times 5\frac{1}{2}$ *inches; 340 pages; maps and illus.* 30s

SIR GEORGE GOLDIE, and the making of Nigeria. By J. E. FLINT. *Oxford University Press*, 1960. $8\frac{3}{4} \times 5\frac{1}{2}$ *inches; 340 pages; maps and illus.* 30s

THESE TWO BOOKS, forming part of the West African History Series under the general editorship of Professor Gerald Graham, have appeared appropriately almost at the moment of Nigerian independence. Each makes a distinctive contribution to knowledge of the past history of the country.

Nigerian perspectives is an anthology of historical writings, extracted from the works of Arab geographers, European explorers and local writers. Unfortunately, until recent times, there were few Nigerians who left any written record of events in their own history, and such as have survived are almost entirely from the Northern Region. In these circumstances tradition (not always reliable) and archaeology are the main sources of information regarding the pre-European period. Kanem-Bornu in the north-east, known to Arab geographers in the ninth century, is the earliest documented area owing to its long-established intercourse with the states of the eastern Sudan and North Africa. The Hausa states were scarcely known until the beginning of the sixteenth century, when Leo Africanus wrote his *Description of Africa*, and the *Kano Chronicle* (translated by Sir Richmond Palmer), which relates the early history of the emirate, was not compiled until about 1890. Similarly, not until the beginning of the sixteenth century did Portuguese writers begin to describe Benin and the Yoruba states.

The extracts published in this anthology have been chosen with scholarly discrimination. The journals of the early European navigators, explorers and travellers are well represented—Pereira, Barbot and Adams, Clapperton and Barth, Baikie and Mary Kingsley. It is surprising that there are so few early documents of historical interest written by coastal Nigerians in view of their long intercourse with Europeans, especially as Captain Adams reported, in a book published in 1823, that: "Many of the natives write English; an art first acquired by some of the traders' sons, who had visited England, and which they have had the sagacity to retain up to the present period. They have established schools and schoolmasters, for the purpose of instructing in this art the youths belonging to families of consequence." Following this significant extract there is only one substantial African contribution, *A Calabar trader's diary*, written in "pidgin" English in 1787. There are, however, quotations from and references to modern indigenous authors—Johnson, the historian of the Yorubas; Bishop Crowther; and Professor Dike, the Principal of Ibadan University College. *Nigerian perspectives* is likely to be of enduring value to the history student and the general reader. The maps and illustrations are excellent and there is an adequate index.

The second book is not a complete biography, for it deals, as its sub-title indicates, almost entirely with the twenty-four years during which Sir George Goldie was actively engaged in Nigerian affairs. Because most of his private papers were destroyed, the story of the other fifty-five years of his life, before and after the Nigerian period, occupies no more than fifteen pages of the volume.

Goldie was born in the Isle of Man in 1846. After two years at the Royal Military College, Woolwich, he received a commission in the Royal Engineers in 1865 but, having inherited a small fortune from a relative, he left the army two years later. There followed a stay of three years in Egypt and a life of "idleness and dissipation" in France and England. At the age of thirty this man, whose "life hitherto had been noted for its licentious and irresponsible character", got his opportunity. A small firm in which his family was interested, which had begun trading on the Niger in 1869, was in financial difficulties, and Goldie was asked to investigate. He went to Nigeria in 1877 and quickly diagnosed that over-competition between the various European firms

established on the Niger was ruining trade and that combination was the only salvation. In spite of his lack of experience and limited financial means, he succeeded by 1879 in securing the amalgamation of the British firms into a single company, and in 1884 the only three French firms trading on the river were drawn into the amalgamation. Meanwhile, the officials of the company had been active in securing treaties with the chiefs of the riverain tribes which placed their territories under the sovereignty of the company, and similar treaties were made with the Emir of Gandu and with the Sultan of Sokoto, the suzerain of the Fulani emirates of the north.

In 1885 at the Berlin Conference, which Goldie attended as an unofficial member of the British delegation, the British Government was able to claim that British interests were supreme on the Niger, and a British sphere of influence in the country was internationally recognized. In 1886 Goldie's company, renamed the Royal Niger Company, Chartered and Limited, was granted a Royal Charter, giving it authority to govern all the territories covered by the treaties made. The company's objective was trade as well as administration, but it was forbidden to establish a monopoly. It was due to Goldie's hard work and ruthless determination in the face of numerous obstacles that the company was formed and the charter obtained, and during the fourteen years that followed he took a leading part, at first as Deputy Governor and later as Governor of the Company, in its management and the administration of its territories.

The author brings out very clearly the almost continual opposition which handicapped the administration during its regime. There were repeated complaints from other British firms that the company, in spite of the terms of the charter, did in fact exercise a trade monopoly. The tribesmen of Brass, long accustomed to trade on the Niger, maintained that they were practically excluded by the company's regulations from their traditional markets, and raided the company's establishment at Akassa to take a bloody revenge. A military expedition, organized and accompanied by Goldie himself, had to be undertaken against the Emirs of Nupe and Ilorin to stop these chiefs from raiding friendly tribes for slaves. There was friction with the governments of the neighbouring British colony of Lagos and the protectorate of the Niger Coast. In addition to these more or less "domestic" difficulties, there were serious international problems. The German occupation of the Cameroons raised in an acute form the question of the ill-defined eastern frontier of the Niger Company's territories, and this was not settled until 1893 after negotiations in which Goldie, with the British Foreign Office as his mouthpiece, played a leading part. Meanwhile French pressure from Dahomey, on the western frontier, became even more serious. French troops entered areas which the company claimed as being within its jurisdiction and actually built forts in these areas. Such aggression presented a problem which led to the raising of a locally recruited imperial force, under the command of Captain (afterwards Lord) Lugard, to protect the frontiers and it was only after a tense period, during which any indiscretion might have provoked a war, that a frontier settlement was effected. It was obvious, in this critical era of "power politics", that in spite of Goldie's diplomatic skill a commercial enterprise was at a disadvantage in dealing with competitive foreign governments, and this, coupled with the complaints against the company's alleged monopolistic practices, resulted in the revocation of the charter. On 1 January 1900 the British Government became directly responsible for the administration of all the company's former territories, the company receiving monetary compensation and the right to receive, for ninety-nine years, one-half of the royalties on minerals mined within a large area of northern Nigeria.

The terms which Goldie secured for the company's shareholders when the charter was revoked gave the final proof of his ability to get his own way in spite of opposition. He was frequently in conflict with officials in Whitehall but generally got the better of the argument. The author says that: "He never under-stated a case, but would inflate a weak argument to grotesque proportions in trying to overcome reason with aggressive assertion. . . . If he often made himself look ridiculous where trifles were involved, he was masterly in dealing with big issues. Here he could persuade not only his bitter enemies, but statesmen and diplomats who possessed more experience of bargaining

than he." When the conduct of the company in its trading activities or in its dealings with the people of Brass came under enquiry it was generally found that the letter, if not the spirit, of the charter had been scrupulously observed. Intent at first on making a commercial success of the company which he had formed, Goldie gradually came to take more interest in the government of its territories, and it is significant that he gave up his connection with it when it became, in 1900, an ordinary trading organization.

The author reminds us that it was Goldie who revived the idea of a chartered company as the means to the acquisition and ruling of territory, and although "the great practical task of establishing a really effective system fell to Lord Lugard", it was Goldie who "laid down the theroetical basis for what was later to become known as indirect rule". It is also suggested that Goldie's policy was in effect "Lugard's 'dual mandate' reduced to purely economic terms". The indigenous people had a duty to the world to exploit their resources effectively through trade; Europe, or the power controlling the region, had a duty to administer wisely and reform the social system so that the society might properly perform its duties.

Goldie had many faults and made more enemies than friends, but the friends he did make "were steadfast and devoted to an intense degree". Among these friends was Mary Kingsley, who described him as "a splendid weapon both to fight red tape and foreigners". Some people seem almost to have been permanently hypnotized by him, and it is suggested that at one time even Lugard was "fully under Goldie's quasi-hypnotic influence". Goldie was an eccentric—sometimes a fanatic—and there were times when he severely tried the patience of Whitehall. During negotiations for compensation to the company on the revocation of the charter, Joseph Chamberlain was provoked into writing: ". . . It looks as if he was trying to force our hands in favour of the company. . . . I should take a very high line with him and tell him that in this crisis . . . we cannot allow him to dictate terms. Bear in mind that his company is very unpopular and that he would find few friends to defend him either in Parliament or in the country." Yet in spite of his frequent disagreements with authority, he was offered (but refused) more than one colonial governorship, and appointments (which he accepted) to Royal Commissions.

Although Goldie destroyed all his papers before he died, and gave no help during his lifetime to would-be biographers, Dr. Flint has gleaned sufficient information from official and company records to present us with a penetrating study of the influence of an extraordinary man on British policy, and the methods employed by a Victorian imperialist to bring Nigeria under the British flag. The illustrations and maps are worthy of this well-produced book.

ALAN BURNS

REVIEWS

EUROPE

ATLAS OF EUROPEAN BIRDS. By K. H. VOOUS. *London: Nelson*, 1960. 14 × 10½ *inches; 284 pages; maps, gravure plates.* 70*s*

The chief feature of this work is the series of distribution maps showing the world breeding range of 419 species of birds breeding in Europe west of the Ural mountains and for this purpose Iceland and Spitsbergen are considered parts of Europe. The object is to provide an insight into the zoogeographical problems connected with the different species and, with the aid of the explanatory text and photographic illustrations, to attempt to clarify the extent to which these species are persisting or extending their ranges. At the beginning of the book the various faunal types are listed and described together with details of the zoogeographical regions and climatic zones. The author then deals with each species individually giving the faunal type and present breeding range, followed by a description of habitat, food and nesting requirements, all of which influence distribution, and concludes with a note on movements. The comparative studies are intended to help in obtaining a better

understanding of the problems concerning the various species and the position of each within its range. It is curious that such well-known species as the Gannet and Greater Flamingo give no indication of their respective geographical origins nor of the faunal group to which they belong.

The book is well illustrated with photographs, by leading bird photographers, of 355 of the species included; the object of these is not for purposes of identification but to show the bird in its characteristic habitat for study in conjunction with the text.

It is fortunate that Professor Voous has himself written the English edition of this work, which originally appeared in Dutch, and therefore there is no loss in translation.

P. BARCLAY-SMITH

THE COAST OF ENGLAND AND WALES IN PICTURES. By J. A. STEERS. *London: Cambridge University Press*, 1960. 11 × 8 *inches;* 146 *pages; maps, plates, diagrams.* 30*s*

The reappearance of Professor Steers's *Picture book of the whole Coast of England and Wales* in a new, larger and more elaborate format constitutes a welcome addition to the already impressive list of books and research papers on coastal topics which have been written by members of the Cambridge school of geography. The original *Picture book* was issued in 1948 and was prepared from the illustrations in the larger and comprehensive *Coastline of England and Wales* (1946). Since that time, however, there has been accumulated in Cambridge under Dr. J. K. S. St. Joseph an extensive collection of air photographs many of which relate to the coast. Professor Steers now gives us a well balanced and careful selection of 167 air and ground photographs which systematically cover the coasts of England and Wales. Supporting this photographic survey is an introductory essay which deals with the basic elements of our changing coast—cliffs, drowned river valleys, raised beaches, erosion surfaces, waterfalls, islands, dunes, marshes, shingle complexes and the like, all being discussed in relation to the illustrations.

The book terminates with a short regional commentary on each of ten physiographic units demarcated by the author. These commentaries relate to groups of photographs and are supported by geological sketch-maps. The student who might be somewhat overwhelmed by the detail in *The coastline of England and Wales* (1946) will find these summary accounts invaluable for obtaining a clear, concise and over-all impression of our varied coastline.

There is also a salutary reminder in the survey that the coast is not only under attack by the forces of Nature but also by Man himself. Professor Steers includes a plea for systematic planning and conservation to avoid continual spoliation of the coast. Although so much has now been destroyed by human action the illustrations do not embrace this aspect. One feels that a few well chosen eyesores to contrast with the beauty of those displayed might have been included to reinforce this plea, and to bring home to the general reader the need for planning precautions and continued vigilance.

W. G. V. BALCHIN

PROVINCES OF ENGLAND: a study of some geographical aspects of devolution. By C. B. FAWCETT; revised by W. G. East and S. W. Wooldridge. *London: Hutchinson*, 1960. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 192 *pages; maps.* 21*s*

Professor C. B. Fawcett's well-known book was first published in 1919; it was based on a paper, 'Natural divisions of England', read to the Royal Geographical Society in November 1916 (*Geogr. J.* 49 (1917) 124–41). There was a lively discussion after the paper. Professor Fawcett endeavoured to delimit the main regions of everyday life in England and then to show how the complex pattern of local government areas could be made more consonant with the regions. It is well known that, in his later years, Professor Fawcett contemplated a thorough revision of his book but never carried out the task. However, in 1942 he did produce a revised map of his provinces.

It was most desirable that this thought-provoking essay in regional geography should be reprinted and made available to students. On the other hand, much of the contents of the book, especially its statistics, had become out of date after the lapse of forty years.

The editors have rewritten certain parts of the book, revised its statistics, redrawn its diagrams and added references to publications that have appeared since the book was first produced. Professors East and Wooldridge have carried out this work admirably and given an additional introduction. On the other hand, it is now sometimes difficult to distinguish between what Fawcett himself wrote and what the editors have added or altered. It might have been wiser to reprint the book as it stood, and for the editors to have limited their part to a longer explanatory introduction. Even the revised book is dated: it is clear that the railway network rather than the road system received greater attention from Fawcett when he was designing his provinces. The editors have not completely eliminated the feeling that the book concerns conditions that have passed away. The original book was printed at the end of the First World War on very poor paper and library copies have deteriorated badly. The new edition is well produced and the editors have done a good service in bringing Fawcett's geographical ideas before the public once more; the subject is of great topical interest in view of the proposed reforms of local government areas.

E. W. GILBERT

THE TARNS OF LAKELAND. By W. HEATON COOPER. Foreword by Sir John Hunt. *London and New York: Frederick Warne*, 1960. 10×8 *inches; 207 pages; plates in colour, drawings and key map.* 45*s*

The numerous tarns of Lakeland, many of which nestle under the stern crags of the higher fells, contribute much to the beauty of the mountain scenery from their sensitive response to the rapid changes of light, sky and weather so characteristic of the district. Hence this handsome volume, worthy successor of *The hills of Lakeland*, from an artist born in the district and familiar with all its tarns, is sure to make a wide appeal. Beginning with the Coniston Fells and working round the region clockwise, he describes more than 100 tarns in turn as to geology, glacial or other origin, effluent streams, natural history, scenery and literary, historical and legendary associations, always enlivening the account with personal impressions and reminiscences. At the foot of each section a table gives the altitude, maximum depth, surface area and grid reference of the respective tarn.

Blea Water in the High Street range is the deepest, with a maximum depth of 207 feet, exceeded, among the lakes, only by Windermere and Wastwater. It is of special scientific interest for harbouring a thermocline or sudden drop of temperature at a depth varying with season. Broadcrag Tarn is the highest at 2746 feet, some 400 feet below the summit of Scafell, and just a little lower stands the tiny Fox Tarn described as having been nearly swept away in the late summer of 1958 by a succession of tremendous cloudbursts which dislodged heavy masses of rock. Red Tarn in the bosom of Helvellyn, beneath the great precipice of Striding Edge, is cited as occupying one of the most magnificent of the glacier-carved corries—a last stronghold of the ice. With such a glacial history Wordsworth's reference to this spot as a "huge recess that holds till June December's snow" certainly seems very much in keeping.

There are eighty-seven drawings and sixteen paintings among which the frontispiece is awarded to Sprinkling Tarn, near Great End in the Scafell range, as the one which Mr. Heaton Cooper has found "most satisfying" at all seasons and in all conditions.

L. C. W. BONACINA

SCOLT HEAD ISLAND. Edited by J. A. STEERS. *Cambridge: Heffer*, 1960. 9½×7 *inches; 269 pages; plates and maps.* 50*s*

Few areas of the British, or indeed, of any coast, can have been studied so intensively from so many points of view as has Scolt Head Island. The result is that, wherever coastal problems are discussed, the name Scolt is a household word; to physiographers and ecologists the world over, this is classic ground. The present volume is a revised and much enlarged edition of one produced in 1934. It ranges over almost every facet of the physiography and "natural history" of the island. Some of the authors are world authorities in their own field, others would lay claim to much more humble status. All have combined to produce a work which is comprehensive if not exhaustive. The book is very well illustrated by maps and diagrams. The excellent photographs

include a number of the oblique air photographs for which Dr. St. Joseph is already well known.

It is possible to discern in some of the contributions the germination of ideas which have since brought distinction to their authors. Chapter IV: Physiography, Chapter VII: Pollen analysis of peats and Chapter VIII: Plant ecology, fall within this category. Since these accounts are written for a wider audience than the merely scientific, some basic principles are stated with a clarity sometimes lacking in more weighty volumes. Dr. Godwin's account of the pollen-counting technique, written before the war, is a good illustration.

The coasts of England and Wales are increasingly threatened by "development". Few areas are more worthy of preservation from spoliation than this part of North Norfolk. The fact that Scolt is a National Nature Reserve testifies to this. It is fitting that several of the contributors to this volume should be members of the staff of the Nature Conservancy and that some of the work should have been supported by grants from that body.

C. KIDSON

A GEOGRAPHY OF SCOTLAND: general and regional. By GORDON RAE and CHARLES E. BROWN. *London: George Bell*, 1959. 7×5 *inches; 220 pages; maps, diagrams.* 16*s*

This volume is divided into two, almost equal, parts; the first deals with thematic and the second with regional geography. In the introduction the authors state that this volume is intended for senior pupils in secondary schools and for students in training colleges, and this purpose of a simplified, clear view is generally attained. There are useful table summaries for recapitulation, facts stated simply and yet with suggestions of historical cause and effect, which make for interest to the reader. Occasionally the authors have tended to over-generalize and so lead to a casual pupil obtaining a wrong emphasis. Factually, this work is sound, although the reviewer would query the implication on p. 208 that Orkney has a few hundred motor-vessels for fishing. The diagrams are graphic and bold: that of population (Figs. 34–5) is original for Scotland in its cartographical technique. Crown copyright is acknowledged for a number of diagrams, but surely there is no copyright in a very simplified map of the location of Scottish coalfields (Fig. 22)!

A. C. O'DELL

THE CARDIFF REGION: A SURVEY. British Association Cardiff Meeting 1960. Ed. Sir J. F. REES. *Cardiff: University of Wales Press*, 1960. 10×7 *inches;* xv+222 *pages; maps and plates.* 21*s*

This volume more than maintains the high standard of the Handbooks issued to members of the British Association at their annual meetings in recent years. It was prepared by an editorial board of six, of whom Sir Frederick Rees—a former Principal of the University College of South Wales and Monmouthshire—was the editor, and altogether there are contributions from thirty-two authors. For the purposes of the Handbook the Cardiff region is defined so as to include east Glamorgan, the whole of Monmouthshire and part of Breconshire. The range of topics discussed falls under the standard headings of landscape and climate, geology, botany, zoology, archaeology, history, the growth of population, industrial structure, agriculture and educational institutions. This, however, is not all, for the editorial committee had the excellent idea of adding, for the benefit of visitors to Wales, five special chapters dealing with the Welsh language, place-names, the Latin literary tradition, the Welsh literary tradition and the English literary tradition in the region. Each one of these chapters has been written by well-known authorities on these subjects and together they constitute admirable summaries of modern scholarship in these fields. In fact, they make this volume one of the most readily accessible sources for the English reader wishing to obtain an authentic statement by experts on such matters. Each of the more orthodox chapters contains material frequently treated by the geographer, yet in this volume each chapter is virtually a self-contained essay and no attempt is made to develop a regional synthesis. Such a scheme is, of course, right and proper in a handbook of this kind, but herein, nevertheless, lies its limitation as a contribution

to regional geography. The work is excellently produced—paper, printing and format being most acceptable. In addition, there are twenty-two well-drawn maps and figures, together with twenty-four half-tone plates, many of which are first-rate air photographs. While such high standards are to be expected of the University of Wales Press, they deserve a special measure of congratulation on the production of this volume, concerned as it is with the region in which their own headquarters is located.

E. G. BOWEN

DIE AUFFORSTUNG LANDWIRTSCHAFTLICH GENUTZTER GRUNDSTÜCKE ALS INDEX FÜR SOZIALGEOGRAPHISCHE STRUKTURWANDLUNGEN IN OBERFRANKEN. By RUDOLF FRANKENBERGER. *Münchner Geographische Hefte* **18**, 1960.

STUDIEN ÜBER DIE DIFFERENZIERUNG DER AGRARLANDSCHAFT IM HOCHGEBIRGE IM BEREICH DREIER STAATEN. By INGRID SEHMER. *Münchner Geographische Hefte* **17**, 1959.

DIE BEDEUTUNG DES WEINBAUES UND SEINER NACHFOLGEKULTUREN FÜR DIE SOZIALGEOGRAPHISCHE DIFFERENZIERUNG DER AGRARLANDSCHAFT IN BAYERN. By KARL RUPPERT. *Münchner Geographische Hefte* **19**, 1960.

For a number of years German geographers under the leadership of Professor W. Hartke of Munich have been studying the extent to which geographical variations in land utilization may be related to factors of a social nature, "social" in that they are external to the economic activity of agriculture proper. The best known example is the "social fallow" found in regions of disintegrating peasant society in western Germany, where parcels of land drop out of cultivation not because they are physically or economically marginal, but because it happens that their proprietor has been drawn away into industry or trade. Dr. Frankenberger investigates a similar phenomenon in Oberfranken, the hilly country where Bavaria meets Saxony and Czechoslovakia. Here much land has always been held by small part-time farmers who also worked in local small-scale industries. Today, with Germany's high level of economic activity, they have progressively abandoned their active farming. Often, in this hilly district, they have turned to afforestation as a form of land utilization which demands little attention but keeps the holding in the family. Yet in any village the land so afforested is not necessarily the poorest, the least fitted for agriculture. The criterion for selection is the social one, that the owner happens to be a member of the social group of former part-time farmers.

Clearly, if the utilization of the land is so closely linked with such factors as social structure and national economic development, one might expect to find perceptible differences between neighbouring countries. Dr. Ingrid Sehmer investigates such differences in the Alpine region where Swiss, Austrian and Italian territory meet. She shows how the high degree of industrialization in Switzerland is reflected in the flight of the young even from the remote villages of the upper Inn valley, and in the consequent retreat of arable from the slopes. The more recent rise of Austrian industry has similarly led to a decline in the intensity of agricultural utilization across the state boundary. Meanwhile the German-speaking villagers of the Italian Upper Adige, lacking an outlet in Italian industry, continue the traditional utilization of their open arable strips and meadows. If the idea of physical determinism still lingers anywhere, it would surely be removed by this study of the striking geographical contrasts between villages in like environments, divided only by national boundaries.

Dr. Ruppert's investigation concerns the adjustment of farming following the retreat of vine cultivation in the valleys of southern Germany. It is a matter of common observation that vines are frequently followed by high-value crops such as fruit or vegetables, and most of us, if we have thought about the matter at all, have probably attributed this fact to climatic advantages. However, Dr. Ruppert demonstrates that there are strong social forces operating in the same direction. A family can live on quite a small area of vines, as little as $2^1/_2$ acres even today. Holdings are

both small and fragmentary. If a structure of holdings of this size is to survive the abandonment of vines as a crop—and in peasant Germany the forces of conservatism are very strong—then only crops requiring much labour but selling at a high price can be considered as substitutes. A specialization in fruit, hops, vegetables, tobacco or some such high-value crop becomes inevitable.

These three studies share a common point of view, that the utilization of land in a peasant society is determined not only by physical geography, not only by purely economic considerations, but also by social factors, notably by the attempt to keep in being the existing pattern of land ownership and the existing social structure of the village. The results obtained by these three workers deepen and enrich our understanding of the agricultural and settlement geography of continental Europe.

T. H. ELKINS

DIE OBERFLÄCHENFORMEN DES VOGELSBERGES. By WILLI SCHULZE. *Marburger Geographische Schriften, Heft* 13. *Marburg*, 1959. 9×6 *inches; 195 pages; maps and line-drawings*

Vogelsberg, north-east of Frankfurt-am-Main and at the southern end of the Hessian corridor, is the largest basalt mass of continental Europe. The hill reaches over 2000 feet in height, and has a radial pattern of drainage with streams flowing south and west to the Main, and north and east to the Weser. The hill-slopes do not rise smoothly, but by way of a great series of erosion surfaces. Schulze first presents the evidence for these levels by describing the interfluve profiles and the thalwegs. The interfluves show as many as seven distinct levels but two are predominant: that at about 770 metres, designated the PI surface; that at 500 metres, designated the PII surface. In the valley profiles, four major terraces are detected. The description of these various relief facets is detailed, but for the majority of British geomorphologists the most interesting section of the work is that concerned with the interpretation.

The PI surface is considered to be a *Piedmontfläche*, separated from the PII surface by what was originally a uniform steep slope, the *Piedmontstufe*. The identification of these surfaces is made in accordance with Penckian criteria, e.g. knick-points at the foot of the *Piedmontstufe*; many V-shaped valleys, some with convex slopes, cut in the *Piedmontstufe*. The many smaller surfaces at intermediate positions between the PI and PII are, however, not regarded as *Piedmonttreppen*, but as features cut to a local base level, *Lokalverebnungen*. These local surfaces have in fact been cut into the *Piedmontstufe*, thus dissecting the originally smooth slope into a series of surfaces. The rejection of the *Piedmonttreppen* identification of the local surfaces is argued on such grounds as the presence on surfaces at the same height of material of different age. This discussion on the origin of the PI and PII, and of the local surfaces, is necessarily of interest to us as an example of the application of Penckian views in modern German work. Also of interest is the chronology suggested. The basalt is probably of Miocene age, and the PI surface is considered to be Mio-Pliocene, uplifted in the Rhodanian mountain-building phase. Similarly the terraces are associated with orogenetic phases, e.g. Wallachian, for the uppermost terrace. In other words, an orogenetic rather than a eustatic or climatic origin is envisaged, mainly on the evidence of buckling shown by the uppermost terrace. Since similar evidence of buckling has been noted in the Rhine terraces in the Rhenish uplands, and in the Danube terraces in Bakony Wald, the consequent emphasis on "structure" is one of the ways in which German work differs from that in this country. Not, of course, that German work is in any sense uniform. The orogenetic phases giving rise to the terraces are interglacial in date, whereas the Rhine terraces are generally considered to be of glacial date, and are interpreted by exponents of *Klimamorphologie* as having primarily a climatic origin.

In short, this work is of interest as an example of some of the trends in German morphological studies. Unlike some German texts, the reasoning is not difficult to follow, and the work may be recommended to those concerned with theories current on the Continent. It is noteworthy that this publication is one of a series produced by Marburg University, and this again draws attention to the great number of good geographical publications available to German research workers.

E. M. YATES

L'ITALIA. By ROBERTO ALMAGIÀ. *Turin: Unione Tipografico-Editrice Torinese*, 1959. Two vols. $10\frac{1}{2} \times 7\frac{1}{2}$ *inches; pages* xiv, 1–670; 671–1320; *maps, plans, illus.*

This important work is the first attempt at a single full-scale survey of the geography of Italy for more than fifty years. A. Mori's useful *Italia: caratteri generali* (1936) has no regional section at all. Not since Marinelli's *Italia* (1902) and Fischer's *La Penisola Italiana* (1902) has such a task been attempted. Prof. Almagià's undoubted qualifications and the magnificent scale of the publication will make this the standard work for many years. There are two large volumes, the first devoted to physical geography and the distribution of population, the second to economic and social combined with regional geography. In this second volume the author uses a compromise between regional and topical treatment similar to that found in Demangeon's volumes on France in the *Géographie Universelle*. In the chapters on physical geography there is an unfortunate impression of old-fashionedness, which perhaps arose from an attempt to combine popular and scholarly treatment. The lavish use of photographs of scenery (not always closely related to the text) scarcely makes up for the paucity of maps, diagrams or geological sections, and for the omission of references to some recent research trends (e.g. on tectonic morphology).

In the second volume there is an impressive general treatment of economic geography, a valuable complement to F. Milone's exclusively regional work. Many of the maps are specially drawn and have the merit of standardization. Probably no other European country has such rich statistical resources as Italy, and perhaps more use could have been made of the wealth of published agrarian studies. In the later part of the book the regional treatment is rather disappointing. Summaries of the evolution of individual cities overload these chapters at the expense of treatment of the characteristic traits of the regions themselves. Criticisms of small flaws in a work of this magnitude should not be allowed to obscure the gratitude that all serious students of Italian geography will feel towards Prof. Almagià for having tackled and successfully concluded so vast a task. The merits of the work are outstanding and it fills a definite gap in the literature. J. M. HOUSTON and A. F. MARTIN

VENICE. By JAMES MORRIS. *London: Faber and Faber*, 1960. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 336 *pages; maps and plates.* 30*s*

This book, we understand, was at once a "best-seller", and it is easy to see why. It is not a scholarly and authoritative account of Venice in the tradition of Molmenti, but an essay in "the higher journalism" by an author who describes himself frankly as a reporter. Yet it is much more than a collection of subjective impressions, for Mr. Morris, who seems to have made a thorough exploration, not only of Venice and her surroundings but also of the voluminous literature about her, supports his statements with a wealth of historical and sociological detail which is always interesting and often highly entertaining. It is weakest where most books about Venice are strongest—on Venetian art and architecture, and at its best on the people: it might be described, indeed, as an elaboration and modernization of W. D. Howells's *Venetian life*. Its style lacks the distinction of that classic, but its scope is wider and it includes a section on the Lagoon and its geography (of which the author gives a good account, though there is an odd passage on page 177 which seems to assert that volcanic forces are actively pushing up the water level). There are a number of photographs, rather capriciously chosen, and two useful sketch-maps; and altogether the book can be recommended to those who know enough about Venice to want to know more and can separate the author's facts from his often very personal sentiments and opinions. L. COLLIER

ASIA

THE STORY OF INDONESIA. By LOUIS FISCHER. *London: Hamish Hamilton*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* x+341 *pages; illus. and sketch-map.* 30*s*

By any standards this is one of the best general books which has yet appeared on the new Indonesia. As was to be expected from the author of *The life of Mahatma Gandhi*, this latest work is generally sympathetic to the aspirations of Indonesian nationalism,

though Mr. Fischer nevertheless finds room for some telling remarks on the desirability of constitutional modification so as to give greater representation to the outer territories. His references to the population problem are likewise interesting. Thus he recalls that whereas Pandit Nehru has suggested that Indonesia should concern itself with birth control, President Sukarno appears confident that the country could feed 250 million people, which is approximately three times its present population. Yet although Mr. Fischer appears to share Nehru's more cautious view on this matter, he is nevertheless more optimistic than this reviewer concerning the natural wealth of Indonesia. Be that as it may, however, the book deserves to be strongly recommended to all those who wish to understand what lies behind the bewildering snippets of news which reach us from this disturbed but fascinating part of the world.

CHARLES FISHER

NEPAL: a cultural and physical geography. By PRADYUMNA P. KARAN with the collaboration of WILLIAM M. JENKINS. *Lexington: University of Kentucky Press*, 1960. 10 × 7½ *inches; 100 pages; maps, plates.* $10

This well-produced volume is a most useful general introduction to the geography of Nepal. The author, an Indian geographer from the neighbouring state of Bihar, has drawn on literary sources as well as on his own experiences of some part of Nepal and, considering the scantiness of data on many aspects of Nepal geography, he deserves credit for presenting a reasonably well rounded picture of a country which until ten years ago was largely unknown to Western scholars. The twelve brief chapters deal with the historical and political setting, the physiography, climate, vegetation and soil, land use, settlement patterns, ethnic and religious division, disease and diet, minerals, power and industry, transportation and trade, and ends with a definition of nine major geographic regions. Each of the chapters is supported by one or more maps and there are also numerous photographs and some line drawings. Somewhat surprisingly in a geographic work, many photographs are without captions indicating the location of the scenery depicted, and it should not have been difficult to find photographs of human types more representative than some of these included. Such sections as those on population density and growth, sex ratio, size of religious and linguistic groups, and literacy are based on the official census reports, and share with them some obvious defects inevitable in a country where basic demographic data have largely to be collected by untrained personnel. In the chapter on the physiography of Nepal the results of the geological survey undertaken over a number of years by the U.N.O. expert Toni Hagen could not yet be fully utilized, but a preliminary account recently published by Dr. Hagen in the volume entitled *Mount Everest* (Zürich 1959) has since become available.

The chapters on the populations and diverse culture patterns represent a satisfactory summary of the information contained in the older books, and the few publications which have so far resulted from field research carried out since 1951 when the interior of Nepal first became accessible to travellers and anthropologists. The many gaps in this information, relating particularly to Western Nepal show, however, how much remains to be done. The very full and carefully prepared bibliography is a great asset to this attractive volume.

C. VON FÜRER-HAIMENDORF

AFRICA

THE JOURNAL OF AFRICAN HISTORY. Vol. I, No. 1, 1960. *Cambridge University Press.* 9½ × 6 *inches; 187 pages. Annual subscription: 30s for two parts; 20s a copy (post free)*

Geographers will welcome the appearance of this new journal in the sister field of history, not merely because there is so much coming and going across the frontier zone between the two subjects but because it concerns itself with Africa. Political developments in that continent make us painfully aware of the rudimentary character of our knowledge of it. In geography, we are still only beginning to understand the physical

milieu of Africa and, even in those rare areas where facts are relatively abundant, we understand enough of the physique to realize that in Africa, perhaps more than in most places, the non-material factors are of great weight. Geographers, therefore, are particularly glad to see progress being made in the Africa field in the social sciences and in history, for much of this brings grist to their mill. Africa presents the historians, too, with a special problem, for so very little of its history, virtually only the last century, is documented. Much historical research in Africa, therefore, must find its basic information either in the oral traditions of its people or in material finds—by archaeological methods, in fact, though such methods may be used for much more recent periods than is customary in Europe. It is not surprising, therefore, to find in this *Journal* one article specifically on the problems attending the extraction of historical fact orally, one on the archives of modern African states and several on non-documented history. The spread of interest in both time and place of the ten articles could scarcely be wider and most of them are of concern to the geographer specializing in Africa.

Reviews are an important feature of this journal. A representative selection of texts is dealt with (though it is in some cases years since the volumes were published) at more length than is commonly met with. Perhaps the most noteworthy feature of the journal, however, is the wide distribution of the authors. The ten articles come from eight different countries; even the reviews are international. R. MILLER

RIḤLĀT BURCKHARDT FĪ BILĀD AL-NŪBAH WA'L-SŪDĀN. By JOHN LEWIS BURCKHARDT. Translated from the English by Fu'ād Andrāwus, with critical introduction by Moḥammad Maḥmūd al-Ṣayyād and topographical commentary by al-Shāṭir Buṣaylī. *Cairo: al-Ma'arifah Press*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 394 *pages; maps*

This Arabic translation of Johann Ludwig Burckhardt's posthumous *Travels in Nubia* (London, 1819) by an Egyptian team is a reminder of the international character of Nile Valley studies. For Burckhardt's first sponsor was the Association for the Promotion of the Discovery of the Inner Parts of Africa (African Association for short) which amalgamated with the Royal Geographical Society in 1831. His latest sponsor, the Egyptian Historical Society, under the patronage of an Elder Statesman of Sudanese historical researches, Professor Shafik Ghorbal, has published this translation which Burckhardt, himself a gifted Arabist, would certainly have approved.

Of course, in every translation, something has to be jettisoned, somebody has to suffer, and here the sufferer is the reader limited to Arabic. He is provided with a scholarly commentary to the text but he has to put up with maps which he cannot read; it would have been too expensive to extend translation to the maps which are photographically, and excellently, reproduced in facsimile. Measured by the best Egyptian workmanship the quality of printing of the text is poor. But there are some sensible modifications of the English original; the long memoir of Burckhardt's life and travels, which forms no part of Burckhardt's text, is replaced by a fresh introduction addressed to Arabic-speaking readers familiar with the Nile Valley but not with Burckhardt, while the three appendices of the original have been omitted. In one particular the translated version improves upon the original: it has an index. The list of corrigenda (seventy-one corrections) is an unhappy feature of even the best Arabic book-making and must be accepted with resignation. What is of more importance than these technical details is the implied challenge by the authors of this praiseworthy undertaking to our countrymen to embark upon the Englishing of the nineteenth century Arab travellers in Africa. RICHARD HILL

TRIBES OF THE SAHARA. By LLOYD CABOT BRIGGS. *Cambridge, Mass.: Harvard University Press; London: Oxford University Press*, 1960. 9×6 *inches;* 295 *pages; maps and plates.* 32*s* 6*d*

The real difficulty in reviewing Dr. Cabot Briggs's book is that it is so much less adequate than its progenitor (if one has read it)—*The living races of the Sahara Desert*, being paper Vol. 28, No. 2, 1958, of the Peabody Museum, of Harvard University; for all that, this "paper" of 217 pages and 74 plates does not possess so good an index as

the "book", but it is much more illuminating and much better value; moreover, its title is far more accurate. The title of Dr. Briggs's book says that it is about "Tribes of the Sahara"—but it is not. It is, in fact, about the races of the Sahara which he has decided to describe by selecting characteristic septs, or clans, of races, and in doing so does less than justice to himself or to the races themselves. Thus, by selecting the Berazga sept of the Cha'amba nomadic Arabs he does an historical and ethnological disservice to the many other nomadic Arabs of North Africa. Similarly, he selects the Ahaggar Tuareg and says little about the Azger, Asben or Ifoghas Tuareg, among whom the ancient history of the Tuareg race may perhaps be more readily found than in the (in the recent forty years) more insulated and sophisticated life of the northern confederation. These instances could be multiplied; Dr. Briggs's sampling method is not satisfactory. It is no doubt due to the approach that there is the rather surprising omission in the book of all but passing references to the early studies of the Berber people by Ibn Khaldun, Leo Africanus and El Bekri. Nor does Dr. Briggs contribute anything to the great historical problems of who were the Garamantae, the Troglodytes, the Leucaethiopians and the Blemmyes of the classical authors, of the introduction and impact of the camel, of the proto-historical existence of animal-drawn vehicles, and so forth.

Despite these perhaps critical comments, Dr. Briggs has prepared an eminently readable, interesting and well-produced book, introducing the people of the Sahara to the growing number of modern Europeans who are penetrating North Africa. The sharp differentiation between the matrilineal Berber people and the patrilineal Arab and probably other Saharan people stands out clearly. I personally doubt whether he is right in supposing (pp. 34–5) an immigration of the Berber people (to use the word in its general or popular sense) "about twelve thousand years ago . . . in the north-western coastal zone of Africa": this may be a slip for "north-eastern", since he goes on to say that those people belonged to the same basic racial stock as the earliest known inhabitants of the Near East and the Greek peninsula, and that they moved westwards along the shore-line of North Africa. There is growing evidence to support such an origin for the present existing Berber-speaking people, but the advent in North Africa of the first wave was also probably by the north-east, as certainly was the later wave, which was possibly associated with the "sea people" migrations. And both waves very likely were more recent than the ages suggested by Dr. Briggs. RENNELL OF RODD

FORT JESUS AND THE PORTUGUESE IN MOMBASA 1593–1729. By C. R. BOXER and CARLOS DE AZEVEDO. *London: Hollis and Carter*, 1960. $5\frac{1}{2} \times 8\frac{1}{2}$ *inches;* xxvii + 107 *pages; plates, maps and plans.* 21*s*

Fort Jesus has been recently restored, and a museum of coastal antiquities erected in its courtyard, thanks to the initiative of Mr. James Kirkman and the generosity of the trustees of the Calouste Gulbenkian Foundation. The appearance of this book, accordingly, is most timely.

The book is in two parts. In the first Professor C. R. Boxer skilfully sketches the history of the Portuguese in Mombasa and on the adjoining coast, from the first contacts to the date of the final expulsion of the Portuguese. This history was eventful, since most of the Swahili resented foreign intrusion. In 1631 the local sultan and his followers massacred the garrison and Portuguese residents. The Portuguese returned, and the ivory trade continued to yield some profit, but the rise of Oman made more critical the hold of the Portuguese on the coast. Events culminated in the remarkable siege of Fort Jesus of 1696–8. For a time the only defenders were seventeen loyal Swahili. Mismanaged relief expeditions failed to raise the siege; the landing of reinforcements only postponed the final fall. The reoccupation of 1728–9 was a mere epilogue. In the second half of the book Dr. Carlos de Azevedo very competently surveys the military architecture of the fortress which, laid out by Giovanni Batista Cairati, is a masterpiece of Renaissance fortification. Appendices list Portuguese captains and governors; sultans of Mombasa and Malindi, Imams of Oman, etc.; inscriptions in the fortress are transcribed, and there is a glossary.

The book is well illustrated with maps, plans and photographs, the latter mainly from Dr. Azevedo's camera. The map of the Swahili coast, however, spells numbers of place-names differently from modern Kenya, Tanganyika and Moçambique custom and several differ from the spelling in the text. An inset map is mis-labelled "Lamu Archipelago, or Bajun Isles." E. AXELSON

A NEW EARTH: an experiment in colonization. By ELSPETH HUXLEY. *London: Chatto and Windus*, 1960. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 288 pages; maps and plates.* 30*s*

Another book by so competent an observer as Elspeth Huxley is always welcomed by geographers with African interests, particularly when the subject is African settlement in Kenya. "The settlers of today are Africans, who in the last ten or fifteen years have surged over the empty spaces of their lands to colonize new areas". Hitherto Kenya has all too frequently been regarded as of interest mainly as a white settler country remote from South Africa with only one small Afrikaner settlement, that of Uasin Gishu reached by the last trek wagons in 1908. Yet Kenya's chief settlement problems concern Africans, particularly those who are landless or whose holdings are too broken and scattered for satisfactory working. Here are accounts of the work of the African Land Development Board, of the personalities concerned, of the creation of new small holdings as the first stage of a plan to raise living standards and give the economic strength needed to support self-government. Yet although the Government and its agents, particularly agricultural officers, are the chief promoters of resettlement, they are also the chief limiters of such settlement since they insist on the separation of tribes. Kikuyu as Mau Mau detainees may dig irrigation channels at Marigat, but they may not farm there as free men for the land belongs politically to the Tugen. Although a Kikuyu may now buy land in the White Highlands, yet he still cannot do so in the territories of other tribes. "This is a book about Progress striding through a part of Africa . . .", but the author clearly has her doubts about Progress when she writes of the casualties that must go down before it.

The descriptions of landscape and peoples can hardly be bettered. Mrs. Huxley's books are always very readable and there are some asides of especial interest—for example the description of bush control by a herd of giraffe and soil erosion produced by guinea fowl. But where are all the places in this account and where are the peoples of Kenya located? The "physical and general map of Kenya at end" affords few clues and a part of the value of this work is lost. Again there are many excellent photographs, but those comparing "before and after treatment" should show the same places and be taken from approximately the same viewpoint, otherwise the reader is misled. The photographs facing pages 32 and 161 are particularly bad examples of this.

Mrs. Huxley has an intimate knowledge of Kenya and its people. One hopes that soon she will write the truly critical account of the resettlement work that is being done there and of the other manifestations of Progress, for which her researches have so fitted her. How successful is resettlement? What new problems are being created, physical in addition to human, by the work of the "agricolas"? W. B. MORGAN

THE STORY OF THE RHODESIAS AND NYASALAND. By A. J. HANNA. *London: Faber and Faber*, 1960. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches 288 pages; maps and plates.* 21*s*

Dr. Hanna's book follows that of Mrs. Huxley in having no adequate location diagram and has only a few illustrations. The theme is the development of British Central Africa, but the approach is that of the historian, beginning in 1829. Six pages suffice to describe the country and eighteen to describe conditions before 1829. This is essentially a book about Europeans in Africa with only a small portion about the Africans who form the vast majority of the peoples of this territory. "This is the white man's achievement; it is also his dilemma". Chapter I contains a curious account of the formation of "kopjes" and vague and misleading statements such as: "The natural vegetation in both the Rhodesias and in Nyasaland is sparse, coarse grass in the drier parts and various types of forest according to altitude and moisture". For the rest the book is a straightforward general history beginning with the work at Moffat's mission

station at Kuruman and describing the development of missions in Central Africa and of the African Lakes Corporation and the British South Africa Company, and the introduction of government.

In the last four chapters Dr. Hanna adversely criticizes the activities of white settlers in the Rhodesias and the treatment of such visitors as Mr. Stonehouse in 1959 and the Indian press attaché in 1958. He describes the processes beginning in 1915 which led eventually to federation and the ways in which the new political organization was burdened by the hostility of most of its subjects from the start. "But if federation was the wrong policy in the early 1950's, it would be false logic to assert that the breaking up of the Federation would be the right policy in 1960". The outlook is pessimistic . . . "it is too late to mend the past; it is a heavy enough task to try to save the future".

Whatever one's views on the wisdom of federation, Dr. Hanna is worth reading in these last four chapters which compensate for the dry account in the first six. The work suffers from trying to be both a serious study and a popular commentary. It is in part more successful as the latter.

W. B. MORGAN

ANGOLA: Portugiesisch-Guinea, São Tomé und Principe, Kap Verde-Inseln, Spanisch-Guinea. By R. v. GERSDORFF. Die Länder Afrikas, No. 25. *Bonn: Kurt Schröder*, 1960. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 165 *pages; maps.* DM.10

The purpose of this series of the German Africa Society is to provide information on political and economic developments in African countries. Books in the series are not intended as academic treatises, but rather as compendia providing the businessman and traveller with an outline of the natural and cultural background of African territories. Ralph von Gersdorff is an economist. After a brief introduction about land and people (pp. 9–27), and a good description of Angola's political development (pp. 27–42), he gives us a fairly detailed and objective account of her economic structure (pp. 42–122). The last chapter on Angola is a short summary of the social and cultural situation (pp. 122–33). This is followed by less than twenty pages on Portuguese and Spanish Guinea, São Tomé, Principe and the Cape Verde Islands.

While the Angola section of the book is a reliable, if rather factual presentation, based on the author's own experiences, the part on these other territories is too short to provide us with anything more than a mere skeleton of basic information. Although Portugal regards her colonies as overseas provinces, which will have many administrative similarities, one doubts whether it was wise to include the West African ones—and even Spanish Guinea. Von Gersdorff, who now works with the Harvard University Centre for International Affairs, has written one other volume on Moçambique. This appeared some time ago in the same series (No. 14, pp. 136, DM.5.40).

WALTHER MANSHARD

WILD LIFE IN AN AFRICAN TERRITORY. By F. FRASER DARLING. *Oxford: University Press*, 1960. $8\frac{3}{4} \times 5\frac{1}{2}$ *inches;* 160 *pages; coloured frontispiece and* 3 *sketch-maps.* 25*s*

This is a study made for the Game and Tsetse Control Department of Northern Rhodesia, a region which holds some of the finest faunal areas left of the old Africa. During 1956 and 1957 the author made three journeys respectively to the Luangwa Valley, the Plateau and the Kafue Flats; Kenya, the Kafue Basin and Barotseland; and to the Bangweulu Swamps, Mweru Wa'ntipa, Sumbu, Nyika Plateau and East Luangwa. A description of these very diverse habitats, at different seasons, is followed by a chapter on the incidence of fire and its general effects. The main interest of the book, however, lies in the ecology of biological communities and the economic use of game stocks in Africa by controlled cropping. This would seem to afford a better method of land usage than the pastoralism of wild lands by cattle, sheep and goats, which causes gross deterioration of the habitat.

The author advances the thesis that a cropping policy of the wild ungulates, including elephants, would give a higher and more continuous protein offtake than the pastoralism of wild land. This report by a leading ecologist should receive careful

consideration by all those concerned in the good stewardship of African territories or interested in the conservation of nature and natural resources. EDWARD HINDLE

NORTH AND SOUTH AMERICA: ATLANTIC

ANGLO-AMERICA: a regional geography. By EARL B. SHAW. *New York: John Wiley & Sons. London: Chapman & Hall*, 1959. 8½ × 6 *inches*; vi + 480 *pages; maps, illus.* 62*s*

Professor Shaw has added another to the growing number of excellent one-volume textbooks on the regional geography of North America north of the Mexican border. Into the short space of 450 pages he manages to pack an extraordinary amount of well digested, well selected and interestingly described detail on the major regions of the continent. Recent developments and new ideas like the St. Lawrence Seaway, Kitimat, Schefferville, changes in the South, or Megalopolis are well dealt with. The criticism one feels inclined to make applies also to most similar American textbooks. No attempt is made (except in the first twenty-five pages) to give any non-regional or topical treatment, and the regional geography is almost entirely economic. One will look in vain for any account of geomorphological, political or social problems. Even the cities are considered mainly as centres of economic activity. An interesting feature is the list of references to articles in semi-popular or semi-technical periodicals, although for the English reader many of these will be unobtainable. The maps and photographs are restrained and effective. It is odd that a remarkably inaccurate relief model of North America has been allowed to appear on Fig. 5 and on the dust cover.

A. F. MARTIN

THE DESPERATE PEOPLE. By FARLEY MOWAT. *London: Michael Joseph*, 1960. 8½ × 5½ *inches; 272 pages; endpaper maps, woodcuts.* 21*s*

Some years ago Farley Mowat published a book, *The people of the deer*, which excited great controversy. In it he described the appalling conditions in which the Caribou Eskimo of the Canadian Barren Grounds to the west of Hudson's Bay were living in 1947 and 1948. The controversy stemmed from some of his claims that smacked of imagination. This reviewer, himself in the Barren Grounds during the period Mowat was writing about, found some of his statements unbelievable. But the book was saved by two things: Mowat's undoubtedly sincere feeling for a small band of Eskimo who were suffering hardship brought about mainly by the white man's coming, hardships which were not being alleviated by the white man; and secondly, by the forceful style, and at times by the poetry of his writing.

Mowat went back to his Eskimo ten years later and this book continues his desperate plea for his friends. If anything it is an even better effort—and he has made up for his previous shortcomings, some of which he admits. This book is believable, it is beautifully horrifying in its description of what men and women can do to survive despite an inexorable nature and the apathy of officialdom. At times his writing can bring the sympathetic reader, who knows his Eskimo, near to tears; and to relief and pleasure when he describes their happiness in life and living.

How much Mowat's controversial writing has contributed to the new feeling for the Eskimo that has now appeared in Ottawa is not known. Certainly it has done much to force an issue and has brought Eskimo-loving officials into positions where their ideas can have expression. The non-controversial writing in *The desperate people* will, I hope, fulfil Mowat's dream of Eskimo as Canadians. No one reading his forceful passages but must react as he has deeply wanted them to react. Of his style I select a passage in the epilogue (p. 263):

"In the brief summer [the Barren Grounds] is a place where curlews circle above the calling wildfowl in the ice-clear lakes. It is a place where gaudy ground squirrels whistle from the sandy casts of vanished glacial rivers; where the dun summer foxes den, and lemmings dawdle fatly in the thin sedges of the bogs. It is a place where

minute flowers blaze in a microcosmic revelry, and where the thrumming of insect wings assails the greater beasts, and sends them fleeing to the bald ridge tops in search of a wind to drive the unseen enemy away." The Barren Grounds!

T. T. PATERSON

MAN, TIME AND SPACE IN SOUTHERN CALIFORNIA. A symposium edited by William Thomas, Jr. *Kansas: Annals of the Association of American Geographers, Supplement*, 49, *No.* 3, *Part* 2, *September* 1959. $10^1/_4 \times 7^1/_2$ *inches;* xxxviii + 1194 *pages; maps and plates.* $1.50

One of the recent innovations in the publishing programme of the Association of American Geographers, which includes map supplements and the new monograph series*, is the publication of special issues of the *Annals* in which symposia beyond the normal scope of a typical issue may appear. The first of these Supplements has as its theme the effect of man's actions upon the landscape of Southern California, and is largely an exercise in historical geography. It contains five papers, each with comments by a critic. In the first paper, George F. Carter discusses prehistoric man in Southern California, and provides a base from which the subsequent essays can progress. Carrying forward his long-standing argument with the archaeologists—on whose behalf Alex Krieger is able to make a spirited defence—Carter suggests that prehistoric man was present in the region throughout the last glacial period at least, and that, in spite of considerable environmental changes, he underwent very little cultural development. Thus, in the occupance of even the prehistoric landscape "the dominant force was cultural and not physical environmental". The next three papers are concerned with the evolution of major elements in the landscape of Southern California within historical times. First, Homer Aschmann discusses the development and the persistence today of the "wild" landscape—"wild" in the sense of being non-agriculture, non-industrial and non-urban, but nevertheless moulded by the activities of man, more especially the effects of fire. H. F. Raup then traces the transformation and the extent of the region's agriculture from the non-commercial economy of the Spanish missions to the speciality crops and dairying of the contemporary scene. And this is paralleled by Howard J. Nelson's useful summary of the dramatic urban spread and industrial growth of Southern California. These three papers are essentially historical in their approach and they concern the processes affecting the distribution of phenomena rather than periods of time. In the final paper, Edward T. Price skilfully indulges in the contemporary American inclination to project economic trends into the future; and, drawing upon some interesting planning studies, he raises some of the basic issues which face the planning of Southern California's land use today. *Man, time and space in Southern California*, therefore, assembles these diverse yet related essays, adds a select bibliography and more than justifies the present experimental mood of the A.A.G. In addition, it provides a useful regional supplement to *Man's role in changing the face of the Earth* (1956) which was also edited by William L. Thomas, Jnr.

GERALD MANNERS

MONTANA, HIGH, WIDE AND HANDSOME. By J. K. HOWARD. New illustrated edition. *London: Oxford University Press, for Rockefeller Institute Press, New Haven, Connecticut.* $8^1/_2 \times 5^1/_2$ *inches;* 509 *pages; maps and plates.* 40*s*

Mr. Howard is a journalist who has written a highly personalized history of Montana. The heroes and villains of the mines, the range and the homesteads are given dramatic reportage which will hold any attention. Yet the intention is to relate their activities to the nature of the land. Even the fine story of "the shooting of Rattlesnake Jake" is seen as part of a pattern of inevitably changing land use. Drought ("rain is all hell needs") and low prices after 1918 led to the era of planning which is illustrated by specific examples of the people involved rather than in terms of broad policy. Unfortunately the new edition has not continued the account into the post-war period. The name of J. W. Powell, honoured among geographers for his classic study of the

* The first is R. Hartshorne, *Perspective on the nature of geography*, Chicago, 1959.

Colorado River, is here remembered for his far-sighted recommendations for the development of these western plains published in 1878. Many of the troubles chronicled in this book stem from a failure to follow his advice to adapt size of holdings, administrative units and types of farming to natural conditions. The real source of this work, however, does not lie in government reports or the books listed in the bibliography. Its origins are obviously in the daily experience of Mr. Howard and the *Meagher County News*, the *Chinook Opinion* and many other local newspapers. This is a good and readable grass-roots supplement to a more orthodox history of Montana.

W. T. W. MORGAN

WIDEAWAKE ISLAND. By BERNARD STONEHOUSE. *London: Hutchinson*, 1960. $9^{1}/_{4} \times 6$ *inches; 244 pages; plates.* 35*s*

This is an account of the British Ornithologists' Union Centenary Expedition to Ascension and starts with a foreword on the origin of the expedition by Dr. W. H. Thorpe, President of the B.O.U. The object was to study the seabirds and other animals which live and breed on the island, and eighteen months were spent handling and marking thousands of Frigate Birds, Noddies, Boobies, Fairy Terns and Petrels and making detailed studies of their breeding cycles and behaviour. The most remarkable of these cycles is that of the Wideawake Terns, which descend in countless thousands to breed on Ascension at intervals of nine to ten months and form dense colonies known as Wideawake Fairs.

The island was discovered in 1501 by the Portuguese João da Nova Gallego, captain of a merchantman bound for India by the newly established Cape route, and on his return voyage a year later he also discovered St. Helena. Formerly there was a much greater variety of bird life on Ascension but the introduction of cats about 1815 to keep down rats had serious consequences so far as birds were concerned, for the cats soon became numerous and fed on young birds and their eggs. The author refers briefly to the history of the island and was able to study the official records at Georgetown, but much of the information is buried in the files of the Public Record Office. The story of the expedition, which included a short visit to St. Helena, is told in a somewhat colloquial style and is illustrated by excellent photographs. It forms a useful addition to the not inconsiderable literature on this remote island with its outstanding biological interest.

EDWARD HINDLE

AUSTRALASIA AND THE PACIFIC

EUROPEAN VISION AND THE SOUTH PACIFIC, 1768–1850. By BERNARD SMITH. *Oxford: Clarendon Press*, 1960. $10^{1}/_{2} \times 7^{1}/_{2}$ *inches;* xviii+287 *pages; plates.* 84*s*

Fifteen years ago, Bernard Smith published, in *Place, taste and tradition*, a leading work on the history of art in Australia. Now he has extended his range to examine the influence of the South Pacific voyages on European taste and execution, showing how the exigencies of reporting the unfamiliar could hasten a revolution in thought and style. Although the author's main concern is with pictorial art, his basic theme is the interdependence of art and science and he develops it with reference to parallels in every field of expression.

Eighteenth century notions of uncivilized man hovered between the "Gothick" and the idealistic. The impact on English society, in 1774, of Cook's interpreter Omai and, nine years later, of Prince Lee Boo, must have shaken both concepts considerably. But even more did the sketches of the Westalls, Mikhailovs and Goupils who sailed as draughtsmen with the Pacific explorers from Cook to Wilkes. Yet it was by no means a simple progression of ideas. From the first it was an uneven struggle between the *zeitgeist* in art and an urgent desire for exactitude in conveying what had never been seen before. Neo-classicism applied to the savage scene produced some strange effects. Even when naturalism prevailed, as under the stimulus of scientific enquiry it did at last, certain anomalies were irresistible to the artist, who was apt to group his figures or Europeanize his foliage to conform with current convention.

In a separate sequence of 171 plates, often showing successive interpretations of the same scene, the author illustrates a gradual change in the attitude of artist to subject; while in his text he investigates also the counter-influence of the artist's findings upon scientific research. He describes the part played by the Royal Society in this reciprocity of ideas and the authority of Humboldt's writings over the study of natural phenomena; cites the neglected Lord Monboddo—that eccentric but curiously inspired philosopher whose theories of evolution pre-dated Darwin's by more than half a century—and quotes the Encyclopédistes, whose genius, not so much for originating as for adopting and refining new lines of thought, acted as a sort of early Radiodiffusion Française by transmitting them in acceptable form to the reading public of Europe.

Byronic romanticism, Evangelical stricture, fashionable sentimentality—all were at war with the true perceptive in European vision; and Mr. Smith sets out to explore them in every manifestation. His book encompasses such a vast body of material that it is not surprising to find some untidiness of construction, most noticeable in the disproportionate space and attention given to the emergence of a colonial Australian school, in the abrupt conclusion of the main theme and in certain bewildering changes of subject throughout. As for the plates, the problems of choice must have been immense for a series designed not only to meet the references in the text, but to comprise in itself a co-sentient of all the implications in the title. Nevertheless some disappointments might have been avoided. Alexandre Lesueur is represented by a single engraving after one of his Tasmanian scenes. This is unaccountable when one remembers his reputation as a biological draughtsman of the greatest accuracy and, more particularly, the vivid reportage of those rough sketches of aborigines in the Natural History Museum at Le Havre. The important William Westall appears in the same way at second hand. Though it is necessary for the author's purpose to appraise not only the original artist but his treatment for contemporary publication, a deliberate pairing of "before" and "after" might have served us better. G. A. LANGDON

DER STILLE OZEAN. Entdeckung und Erschliessung. By HANS PLISCHKE. *Munich and Vienna: R. Oldenbourg*, 1959. 7¼ × 4½ *inches;* 94 *pages.* DM.3.20

This chronological survey of European discovery and penetration of the Pacific Ocean, from Balboa to the hydrogen bomb, packs a great deal of information into small space. The author, who is Professor of Ethnology at Göttingen, approaches his subject in geopolitical terms, as is perhaps inevitable. In the weakest section, that on the period 1513–1760, a rather spasmodic treatment leads to loss of continuity, and the state of knowledge inherited by successive expeditions from their predecessors is not made clear; thus the obsessive influence of Quiros's discoveries of 1605–6 on later explorers is unnoticed. Maps in fact receive only one mention in the whole book. The two long sections on the greatest voyages of discovery between 1760 and 1830 and on the nineteenth century are much more successful. Although here too chronology is sometimes subordinated to thematic discussion, the sequence of development—commercial, missionary, and political—emerges in clear outline, and the mutual influence of discoveries and contacts on the native peoples and on the European mind is well depicted. The author commands a concrete and flexible narrative style, and his text is easy to read. There is no index; and in a manual of this type, which should provide a guide to further reading, we are entitled to expect a bibliography of more than six items.

R. A. SKELTON

NEW ZEALAND, 1769–1840: early years of Western contact. By HARRISON M. WRIGHT. *Harvard University Press; London: Oxford University Press*, 1959. 8½ × 5½ *inches;* 255 *pages; maps.* 35*s*

The approach in this account of early contact between the native Maoris and the white people is historical. The basis of the book is a discussion of the complex impact on each other of two very different societies. The discussion is limited to the North Island and mainly to the Bay of Islands area, where contact between *pakeha* and Maori

was most extensive in the early days. The first part of the book deals with the Maori background and with the early white visitors, missionaries and settlers. In the second part a close analysis is made of the effect on the Maoris' health of new introductions, of plants, animals and disease. The disruptive effect of the introduction of new weapons in the inter-tribal warfare is considered. Both these factors are shown to have caused serious Maori depopulation.

The third and most thoughtful part of the book is devoted to an interesting analysis of the Maori change of behaviour. The author deals with this problem by examining in turn the European and Maori viewpoint and explains the factors which led to the acceptance of Christianity and its later decline. The part played by the missionaries is fully discussed. A conclusion shows why the happy state of affairs in 1840 did not prevail for long. A bibliographical note concludes the book.

As an analysis of the impact of a more advanced culture on an isolated and, from the material point of view, primitive people, the book makes fascinating reading. Many sources, indicated in footnotes, have been used to gather together all the relevant material. The interaction of many factors are carefully considered in explaining the development of Maori thought and behaviour during this vital phase of their existence when the whole basis of their culture was being changed. C. A. M. KING

WEST COAST REGION. National Resources Survey, Part I. Compiled by the Town and Country Planning Branch, Ministry of Works. *Wellington: Government Printer*, 1959. $10\frac{1}{2} \times 8$ *inches; 180 pages; maps and plates*

This is the first of the Regional Resources Surveys being prepared by the Town and Country Planning Branch of the New Zealand Ministry of Works. The Minister of Works hopes that these surveys will encourage active participation of local authorities in regional planning as well as providing data for other government departments (non-New Zealanders may not know that the Town and Country Planning Act of 1953 provides for the formation of regional planning authorities by two or more local authorities). The publication of this volume in 1959 was opportune, for in that year the New Zealand Government appointed a Committee of Inquiry to review the economy of the West Coast. It is interesting that the committee was appointed and the book published on the eve of the centenary of Westland (1960). This volume, and its successors in the series, will be welcomed by geographers in all parts of the world. Generally the present volume can be recommended to them (although the text contains some errors of fact due to inadequate grooming in proof).

The West Coast region has many problems, some of which are possibly akin to those of certain of Britain's "Development Areas". In the survey under review, the "region" of the West Coast includes Murchison county, as well as the customary "West Coast" counties of Buller, Grey, Inangahua and Westland. The volume was not intended to be a planning survey and should not be regarded as one. It is an analysis of present conditions in the light of the recent past. It contains a brief historical introduction and an even briefer conclusion entitled "Prospect". In between, ten chapters discuss systematically the geology, soils, climate, population, agriculture, coal mining, forestry, employment, transport and the tourist industry. Few of the compilers appear to have worked in the West Coast region. Even fewer seem to have a clear perception of the region and its problems. Generally the text seems to have been compiled in a government office in Wellington by persons far removed from the West Coast and "alien" in descent to the inhabitants. Only the chapter accredited to G. C. Shaw and R. P. Suggate appears to have been written by men who, if not "natives" of the West Coast, have at least lived and worked in the region. It would be interesting to know the names and training of the compilers of the other chapters. There is a valuable list of works used by the compilers in a difficult task. The text is lavishly illustrated; it contains ninety-two photographs (some of which could have been omitted without loss to an understanding of the region's problems), fifty-five statistical tables and thirty-one graphs, maps and diagrams. There are also seven folded maps at the end of the book. Space does not permit of full comments on the maps; the most

thought-provoking one is undoubtedly that showing population changes between 1926 and 1956 (p. 49).

West Coast Region has doubtless already aided the Committee of Inquiry in their deliberations. It would have been of greater value to geographers and others if it had included an over-all appraisal of the relative importance of the region's different resources and economic activities. Perhaps other volumes in the series could include such an assessment? Perhaps these volumes could name the members of the research teams? Perhaps also the compilers of the several sections could all spend some time in "their" region—not working at a desk but in the field. In this way, they would draft their compilations with a real awareness of and feeling for the region under discussion.

EILA CAMPBELL

IFALUK: portrait of an atoll. By MARSTON BATES and DONALD ABBOTT. *London: Museum Press*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 287 pages; maps, plates.* 30*s*

Ifaluk is an atoll of the Caroline Islands on which the authors, who are respectively Professor of Zoology at the University of Michigan and Assistant Professor of Biology at Stanford University, California, each spent some months as members of a scientific team studying its ecology. Their aim in this book is described in the preface as being "to write subjectively . . . about our own reactions as well as about the people and things that we observed".

The book is cast as a narrative of the events and activities of the expedition, each of the authors writing in the first person about the period when he was himself present on the atoll, and between them they cover its whole duration. Their "solution to the problem of joint authorship" requires of the reader a "mental somersault, where 'I' changes from Bates to Abbot between Chapters IX and X"; but the effort is rewarded by the interest of the comparison between the reactions of the two writers to the same situation.

Though no attempt is made to cover its scientific results, the story of the expedition conveys a good deal of information as to its objects and techniques, and there are particularly interesting sketches of the geology and biology of the lagoon and of the islands, and of their significance in shaping the lives of the inhabitants. Outlines of the people's history, of their relationships with one another and with foreigners convey a convincing impression of them both as a group and as individuals with whom the authors are delighted, as with their environment; at the same time the difficulties and disadvantages of their environment and life are indicated, despite the publishers' cliché description of it as "the way of a South Seas paradise".

Books of this increasingly numerous kind are too often superficial, banal and even misleading. This example is, within the limits of its aims, informative and lively, and may well make the reader wish to know more of the subjects it deals with.

H. A. POWELL

PHYSICAL AND BIOLOGICAL GEOGRAPHY

BIOGRAPHY OF THE EARTH: its past, present and future. By GEORGE GAMOW. Revised edition. *London: Macmillan*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xiii + 242 *pages; diags., illus.* 35*s*

The present revised edition of the book is the third, the work having been first published in 1941. The publishers state that the theories of the Earth's origin and age have undergone material changes since the first issue, and that the revised edition embodies the currently accepted theories, which the author believes are "now here for good". The author is Professor of Physics at the University of Colorado; while he is probably better acquainted with the physical aspects of his subject, he covers the geological aspects thoroughly, and writes of both in a manner likely to appeal to the layman. There are twenty-seven plates and fifty-eight diagrams. The plates are well produced and apt; most of them relate to geological subjects, ten being photographs of reconstructions of ancient reptiles and mammals by the American and Field Museums of Natural History. The caption of Pl. XII, showing badland erosion forms, is incorrect in ascribing the

survival of the vertical columns to the weight of the cap rocks, rather than to the protection from erosion afforded by the caps. Figures 38–45, entitled "Cinematographic history of North America", indicate important stages in the geographical development of this continent from the earliest geological times, and show the characteristic forms of life at each stage.

The author does not always distinguish between established fact and mere hypothesis, as in discussing the parturition of the moon from the Pacific region, the shrinkage of the earth and the formation of fold-ranges, on the analogy of the wrinkles of a cooling apple, and the permanence of ocean basins. Also, he states that anything in the nature of continental drift ceased shortly after the departure of the moon, said to have occurred 5000 million years ago and, apart from ignoring well-known later arguments in favour of continental drift, makes no reference to the light being thrown on this question by recent palaeomagnetic observations, which indicate, for example, that in pre-Jurassic time Europe and North America were 24 degrees closer than they are today. It will doubtless be many years before general agreement is reached on these and other major problems. Again, while one admits the necessity for some degree of simplification in a popular work, the author has over-simplified a number of his presentations; for example, the rocks of the crust, apart from limited sediments, appear to comprise only "granite" and "basalt", the former building up the continents and the latter forming a plastic layer on which the lighter continents float, and which underlies the ocean at shallow depth; moreover, no mention is made of the important "Moho" discontinuity which, at a depth of 35 kms. beneath the continents and 5 kms. beneath the oceans, separates the basalt from denser ultrabasic rocks below. A short statement should have been added to show that the "granite" includes not only granite as understood by the geologist but also many other rocks of low density, particularly ancient sediments and metamorphic rocks. Again, on page 120, from the reactions of a piece of granite subject to high compression in a hydraulic press, the author regards it as evident that during 2000 million years of the contraction of the crust, and consequent crushing of the granite blocks, there must have been at least five great epochs of mountain-folding activity! Some inconsistencies have crept into the work, as on page 5 where it is stated that prior to 1½ billion (1500 million) years ago the surface of the earth was too hot to support oceans, whereas elsewhere (page 236) the age of the oceans is given as 3000 million years.

The final chapter, entitled "A glimpse into the future", is admittedly highly speculative; it suggests, for example, that the glacial periods will recur 50,000 and 90,000 years hence and that an appreciably warmer climate will prevail in about 20,000 years; ultimately, the sun will explode and the earth will be melted again! To the uncritical reader the book is, nonetheless, very readable and it should prove of considerable interest; in most respects it affords a general outline of the main trend of events, but in a subsequent edition its value and accuracy would be much improved if faults of the kind referred to were corrected.

F. DIXEY

GEOMORPHOLOGY. By B. W. SPARKS. *London: Longmans*, 1960. 8¼ × 5¼ *inches; 371 pages; text-figures and illus. 37s 6d*

Many of the standard textbooks of geomorphology were written before the war, and new works, which take into account research conducted in the last two or three decades, are to be welcomed. This volume in the 'Geography for Advanced Study' series is both comprehensive and up to date. The approach is "critical [but] traditional rather than revolutionary": the whole field of geomorphology is covered and fluvial, coastal, glacial and desert land forms are all examined in the "traditional" manner. The critical approach is perhaps best seen in the chapters on "The Davisian geographical cycle" and "Erosion surfaces and their interpretation". It does, however, colour the whole book and is demonstrated in an unwillingness to accept unproven hypotheses, even those in current fashion. The discussion of the development of fjords is a good example of this healthy scepticism.

One of the best features of the book is a very lucid style and the avoidance of the use

of unnecessary jargon. The multiplicity of terms in current use, for example, in describing "Karst" topography, are reduced to an ordered simplicity. It would have been pleasant to record that this technique is applied wholesale and that the confusing variety of terms in accounts of, for example, the mass movement of materials on slopes are codified. Unfortunately this is not so and such hybrid expressions as "debris avalanche" are passed on to another generation of students. The clarity of presentation which is such a feature of the book is sometimes dearly bought. The summing up of the effects of Davisian ideas and terminology (page 20) is far too sweeping. Other instances of over-simplification include the inference (p. 196) that dunes higher than 50 feet are only found piled up over solid rocks and the mis-statement (p. 199) that Orford Ness "runs roughly parallel to the coast for its entire length".

These are, however, relatively minor blemishes. The book can be thoroughly recommended. Particular praise must be reserved for the wealth of clear and simple line diagrams and the splendid collection of photographs. It can safely be said that no other textbook of geomorphology has included such superb views of Arran.

C. KIDSON

FRONTIERS OF THE SEA. By ROBERT C. COWEN. *London: Gollancz*, 1960. 9 × 6 *inches; 307 pages; maps, plates.* 25*s*

Oceanography was formerly the concern of no more than the biologist and the mathematician who investigated water movements. Now, these have been joined by geologists, meteorologists, physicists, glaciologists, engineers and others and the result is that it is not easy to keep abreast of developments in all these fields. Mr. Cowen, a distinguished scientific correspondent to various American journals, has thus rendered a valuable service in summing up the state of our knowledge of the ocean "as", he would say, "of now". It is very appropriate, at a time when our scientific probes are reaching out into space and peering at the other side of the moon, to assess the extent of our knowledge of the oceans and to draw attention to our vast ignorance of them. Mr. Cowen deals with all aspects of the subject, from its historical background to details of research vessels. The usual topics are covered with an attractive freshness, but the general reader with only a nodding acquaintance with oceanography will probably find most of interest in the chapters dealing with the evidence that has in recent times been recovered from the depths on subjects such as the composition of the ocean beds—and thus of the Earth itself—of the evidence for past changes of climate and the prognosis for the future, of the possibility of increasing man's marine food-supply and indeed of obtaining minerals, either from solution or by direct collection from the ocean floor.

Much of the modern progress in oceanography has naturally stemmed from new and highly ingenious apparatus, usually involving electronics. Mr. Cowen introduces us to this and here as elsewhere has obviously delved very deeply into the relevant literature, and yet presents his gleanings to us in a most readable and attractive manner. This is not to deprecate the book as "mere journalism"; it offers a great deal to all but the specialist and also points the way, in its selected bibliographies, to further study of the subject.

R. MILLER

UNDERSTANDING WEATHER. By O. G. SUTTON. A Pelican Book. *Harmondsworth: Penguin Books*, 1960. 7 × 4 *inches; 205 pages; charts and illus.* 3*s* 6*d*

In his preface Sir Graham Sutton, who is Director-General of the Meteorological Office, states that this book for the general reader is not designed as a systematic textbook of meteorology but rather as a progress report of the science of the atmosphere. With remarkable clarity he explains the exacting, complicated process, under time-limit, of preparing daily weather forecasts from synoptic charts based on surface and upper air observations, as well as certain new physical concepts which play a great part in the technique of modern forecasting. He foresees (p. 139) a future for mathematical methods of forecasting, which are still in the early stage, since electronic digital computers can solve the equations supplied to those fast enough to keep pace with the weather itself.

In a chapter on micro-meteorology, Sir Graham describes researches of his own into turbulent motion as affecting evaporation and smoke concentration; but, as he himself indicates, the problems of micro-climate are mostly concerned with the layers of air in contact with the soil where seedlings and insects are exposed to drastic vicissitudes of temperature and humidity at short range.

Geographers accustomed to attribute rainfall to depressions, fronts, local convection and the forced ascent of moist winds by mountain ranges should notice the remark on p. 80 at the end of the chapter on clouds, wind and rain to the effect that in *detail* we still do not know the cause of rain. The issue, much discussed by meteorologists today, is how cloud droplets grow into raindrops and why many clouds fail to reach the precipitation stage at all.

On p. 57 the author attibutes the freedom of the South Atlantic from tropical hurricanes to the cooler sea surface, since these vortical storms depend on evaporation over warm seas for the moisture which, on condensation, supplies their energy. But another factor may, perhaps, be connected with the bulge of the neighbouring continents which seem to hinder the convergence, near the Inter-tropical Front, of air currents which have freer play over the other tropical oceans and could serve as a predisposing cause of hurricanes at certain seasons.

L. C. W. BONACINA

HUMAN AND HISTORICAL GEOGRAPHY

OUR DEVELOPING WORLD. By L. DUDLEY STAMP. *London: Faber and Faber*, 1960. 9 × 5½ *inches;* 195 *pages;* 42 *sketch-maps, diagrams and tables.* 21*s*

Rarely indeed do geographers nowadays literarily follow their craft by venturing to survey the whole world and, even though this short and readable book is necessarily selective, it remains a stimulating review of many problems of outstanding importance, if man's estate is to be effectively developed during an age of mounting population numbers and political tensions. *Our developing world*, based on the author's long experience of land use study and extensive first-hand observation, is a veritable tract for the times which deserves to be widely read. Dr. Stamp here returns to the world problems about which he wrote in 1953 in *Our underdeveloped world*, and the implications of the title of his new book strike an encouraging note—and rightly so. While the pace of economic progress has been fast in some parts of the world, it has often seemed slow in relation to ultimate possibilities in many others, notably in many of the new States of Africa and Asia where the attainment of independence, in settling a political problem, merely highlights the more clearly the difficulties of economic advance. It is reassuring to be led back, under Dr. Stamp's guidance, to the basic facts of population, of the land and its resources, and of the natural limitations which political and economic planning must respect. We learn how much is being accomplished and how much can be done in contrasting areas of the world and also how success will depend on the establishment of an active, but also intelligent, partnership between Man and Nature. This involves not only the application to underdeveloped lands of the capital, technology and expertise of the West, but also the understanding of social conditions and local practices from which the West needs must learn (cf. p. 120). After all, as Dr. Stamp reminds us, Westerners (and not they alone) have much misused their chief capital—the land: witness the creation of blanket bog, where trees once stood, and the heavy loss of soil through tree-felling followed by gullying and erosion.

Little attention is given in this book to industrialization, the *apparent* panacea of higher living standards as demonstrated by Westerners. Rather our attention is directed firmly to the ground—to the problems of soil qualities and their management, to the cropping of the soil, and to the mineral (mainly subsoil) resources which provide the bulk of the world's energy resources and its minerals. In addition, the trends of population, as they vary locally, during a century marked by increasingly successful "death control", are discussed and illustrated. At a time when automation might seem to minimize labour power, the population grows fast and, for its increasing consumption needs, must increasingly exact the better use of that quarter of the Earth which is

used for crops. Dr. Stamp has encouraging things to say, e.g. on p. 122. Not the least interesting feature of *Our developing world* are the accounts given of the various ways by which measurement may be made comparatively—of food consumption (by calories), of efficiency of farming output (by a Standard Nutrition Unit), of the stock-carrying capacity of range land, and of the principal sources of mechanical energy. When he returns to all these important and urgent themes in a later edition of this book, Dr. Stamp might consider taking us even further with him by discussing the paradox that industrialization is not everywhere the passport to high living and also, by looking beyond the world of the West, to consider the pace and scale of economic change among that third of humanity which is governed by Communist regimes.

W. GORDON EAST

THE ORIGIN OF CIVILIZED SOCIETIES. By RUSHTON COULBORN. *Princeton, New Jersey: Princeton University Press; London: Oxford University Press*, 1959. $8\frac{3}{4} \times 5\frac{1}{2}$ *inches;* x + 200 *pages.* 30*s*

Dr. Coulborn finds fourteen distinct civilizations, of which seven—the earliest—are "the seven primary civilized societies", of which two were born in the Americas. For each of the fourteen, "agriculture was the key achievement preliminary to civilization" (p. 12) and all were subject to cycles of change—of rise and fall. Each is characterized and identified by its own "style" or "form" (p. 22) and its cultural content consists of cultural "traits" or "complexes" which were diffusable to other societies and environments. The diffusion of traits, in itself, cannot explain the origin of any new civilization and Sir Mortimer Wheeler is chided (p. 25) for thus explaining the origin of the Indus civilization of India. Gordon Childe's materialistic doctrines, as applied to the origin of certain Old World civilizations outside the riverine lands, are also found wanting (pp. 26–7), while Heine-Geldern has brought "only confusion" to the problem of the origin of the primary civilized societies. *The origin of civilized societies* belongs to the A. L. Kroeber school and Dr. Coulborn here makes a lucid, critical, mature and persuasive contribution to a problem of great interest. He here studies how civilization arose in seven independent and separated environments. He finds that water worship and rich soils were often important considerations, that "religion was the positive . . . agency" in their creation and (as also did Childe) that the advance to civilization was achieved with (relatively) great rapidity.

W. GORDON EAST

LAND OWNERSHIP AND RESOURCES. A course of lectures given at Cambridge in June 1958. By Professor Sir Solly Zuckerman, J. Enoch Powell, Lord Parker, C. H. J. Maliepaard, P. A. Stone, D. R. Denman. *Cambridge: Department of Estate Management and Cambridge University Estate Management Club*, [1960]. $8\frac{1}{2} \times 5$ *inches;* 136 *pages; text-figures and tables.* 15*s*

This book, a slightly augmented version of a course of lectures held at Cambridge in 1958, aims to show that individual and national interests in land resources are not identical. It further aims at promoting mutual recognition of these varying interests, and is at least hopeful of reconciliation. But whilst the selection of contributors has assured the presentation of both sides of the argument to some extent, one is left with the impression that it is the individual rather than the national interest which is the vital issue. Some years ago any reminder that the individual had an interest would have been well worthy of note, but recent developments in the field of land use have swung so markedly in favour of certain individuals that a strong statement of the national interest might be more to the point. The original lectures were presumably intended to be supplemented by other work, and the published papers, therefore, might have limited appeal to anyone not already acquainted with the general field. Despite any imperfections, however, this book does draw attention to many divergent considerations which must be borne in mind when dealing with land resource development. The range of topics might well leave the reader feeling that the chances of finding a land expert are very slim indeed. Yet the country purports to have many such people—and these, at least, ought to be acquainted with what is written by authors of such varied background.

NORMAN HILTON

NATURAL RESOURCES. Edited by MARTIN R. HUBERTY and WARREN L. FLOCK. *New York and London: McGraw-Hill*, 1959. 9×6 *inches*; 556 *pages*; *plates*, *text-figures*. 85*s* 6*d*

This volume originated as a series of lectures arranged by the departments of engineering at the University of California for the staffs, students and graduates in industry in order to familiarize them with recent developments and thought. Its twenty-three authors are by no means all engineers but are all associated directly with California, eighteen of them being on the staff of the University of California. Whilst some of the twenty chapters deal exclusively with the United States and with an emphasis on California, others are concerned with the world as a whole. In addressing a non-specialist audience, some of the authors—for example Hans Jenny on "Soil as a natural resource"—have so tried to simplify their subject that naïve sentences convey only half-truths. He claims, for example, that "E. W. Hilgard was the first to recognize the powerful impact of climate upon the mineral regime of soils . . . so he changed the provincial outlook of the soil scientists to world-wide perspectives" (p. 192). On the other hand some of the contributions are almost frighteningly erudite—for example the mathematical relationships between fishing intensity, abundance and catch for given fish in the assessment of marine resources.

It is interesting to note the wide interpretation given to the concept of "natural resources", so that essays are presented on the atmosphere, photosynthesis and air-pollution as well as the normal range of water, land, minerals and power. Two of California's leading geographers, Robert M. Glendinning and Richard F. Logan, have contributed a lengthy chapter on land as a resource. After noting the favourable position of the United States compared with most other countries, Glendinning summarizes the position in his own country with the help of the familiar maps from his *Introduction to geography*, whilst Logan discusses his current interest, the utilization of the arid lands of the world. Read critically as a collection of essays stemming from the particular interests of their authors, this is an interesting and valuable collection with a wide range of information, but it is scarcely a balanced assessment of natural resources either of the world or of the United States L. DUDLEY STAMP

POPULATION. By GERMAINE VEYRET-VERNER. *Paris: Arthaud*, 1959. 6×8¼ *inches*; 266 *pages*; 69 *charts*

The study of population geography, which may be said to have begun in France with Pierre George (*Introduction à l'étude géographique de la population du monde*, 1951), has been much developed in recent years. Many studies have been produced by Professor Jacqueline Beaujeu-Garnier in the *Annales de Géographie* and in her two-volume study *Géographie de la population*, 1956 and 1958; or by Professor Germaine Veyret-Verner in the *Revue de Géographie Alpine* and in her present concise book. This is a study in general demography using demographic terms and methods, but linking them to geographical conditions and outlining new spatial classifications which often escape the attentions of demographers.

In part one, the author deals with such factors of population as birth, fertility, reproduction, marriage, death and other rates, migration, population and age structures. To retain high productivity in ageing societies she suggests "les postes actifs de direction devraient être de préférence confiés à des hommes jeunes et entreprenants, les anciens chefs pouvant se voir confier des missions de contrôle, de conseil ou d'études", views which might be quoted either way in discussing the merits of later retirement for professors, geographical and otherwise!

A most valuable analytical tool is provided by her Index of Vitality, designed to take account of population trends and structure, past and present. In the numerator she multiplies the fertility rate by the proportion of the twenty–forty year-olds to the total population, whilst in the denominator the crude mortality rate is multiplied by the age index (proportion of the over-sixties to the under-twenties). Although, through default of information, no indices could be produced for the critical countries of Brazil, China, India or the U.S.S.R., there are some fascinating analyses of other lands. The

Netherlands appear as Europe's human ant-heap, where not only the Roman Catholics have a high birth-rate, but also the Protestants in order to keep abreast. The Netherlands have the highest birth and fertility rates, the lowest death-rate and the youngest population in Western Europe.

Terms such as "overpopulation", "depopulation", "underpopulation" and "optimum population" are considered in relation to biological, economic, social, historical, political and regional circumstances. In part two the distribution of population and demographic groups are considered fairly briefly. There is a very valuable statistical summary of many rates for forty-one countries and a bibliography which, however, includes only works in French. Mme. Veyret-Verner has elaborated new analytical devices, and has not been afraid of expressing her own ideas, one of which is that "en démographie, comme en économie, le laissez-faire a vécu". R. J. HARRISON CHURCH

MÉMOIRES ET DOCUMENTS: Centre de documentation cartographique et Géographique, Tome 7. *Paris: Centre National de la Recherche Scientifique*, 1960. $10\frac{1}{2} \times 8\frac{1}{4}$ *inches;* 275 *pages; maps and diagrams*

Published under the direction of Georges Chabot, this volume includes six essays concerned with population distribution and economic activity, with an emphasis on contemporary changes, actual or desirable, and their effects on the landscape. The essays are of varying length but two are virtually monographs in their own right—the hundred-odd pages of M. Dubois on the Châtillonnais area, and the sixty pages of F. Hardy on the outward movement of town populations from London, with a special treatment of Harlow. Each essay is a local study of problems such as the transformation of agriculture, the suburban spread of townspeople, or the changing land use in towns.

The long essay on the Châtillonnais shows a change from sheep grazing to intensive cattle production, with mechanization and skilled crop growing within the last thirty years. Another paper, by A. Perpillou, gives a survey of agriculture in southern France from the Mediterranean to the Atlantic, with interesting maps: some areas have heavy population decreases, though not the vine-growing districts. The study of Britain has some interesting comments on Harlow, but is less strong on the general urban and industrial background; it is not true, at any rate yet, that 92 per cent of the population of England and Wales is urban, and the built-up area around London is far more extensive then the highly generalized map on page 145 suggests. And the author's comments on conurbations are vague. The article on the Brianza area, near Milan, by Geneviève Fourneau, contains some interesting material on the penetration of a rural landscape by industries and town workers, but is marred by an inability to construct paragraphs. Marie-Paule Bertin gives a delightful survey of a long Paris street at various periods, and the final essay, by Annie Delobez, shows that in the Thérain valley, from Beauvais to Criel, there is a wide diversity of opinions on farming changes. T. W. FREEMAN

BIOGRAPHY

THE WHITE RAJAHS. By SIR STEVEN RUNCIMAN. *London: Cambridge University Press*, 1960. 9 × 6 *inches;* xii + 320 *pages; maps, illus.* 27*s* 6*d*

PERSONAL COLUMN. By SIR CHARLES BELGRAVE. *London: Hutchinson*, 1960. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 248 *pages; sketch-map, illus.* 30*s*

Rajah James Brooke and his successors in Sarawak have been the subjects of so much romancing and of so much controversy that, now that their rule is at an end, it was high time for an impartial and authoritative account of them and their unique kingdom; and that Sir Steven Runciman has definitely provided. In this detailed and carefully written history he does full justice to James Brooke, whom he pronounces a great man "if there is any meaning in the word greatness"; but he makes it clear that, like some other great men, James was at times a most exasperating man to deal with, while he also does justice to Charles, the second Rajah, a less remarkable and less attractive

personality, but in some ways a more competent ruler. He gives, too, a balanced account of the final cession of Sarawak to the British Crown in 1946, admitting the good reasons for it but describing it as "hurriedly and clumsily handled" and "a story from which few of the principal characters emerge with enhanced credit". It is indeed, as he shows, remarkable, and unfortunate, that the prejudice of Sir Frank Swettenham in favour of indirect rule prevented the absorption of Brunei into Sarawak in 1905, while forty years later the prejudice of the Labour Government and the Colonial Office against it hastened the end of the State of Sarawak itself. Whatever prejudices he is dealing with—and there were plenty in the history of Sarawak—Sir Steven remains urbane and fair-minded; and his book reads at times like the summing-up of a humane and conscientious judge. Somehow, however, it does not read as if it had been a labour of love: with Malays and Dyaks he is not on the same intimate, almost affectionate terms as he was with his crusaders and saracens. From the geographical point of view his account of Borneo and its races is adequate; and so are the two sketch-maps in the book, one of the Far East in the mid-nineteenth century and the other of the north-west coast of Borneo at the same time. The larger map of Sarawak and Brunei, however, is inadequate and confusing: it is supposed to show the successive frontiers of Sarawak, but it is difficult to disentangle one of these from another.

Sir Charles Belgrave's book is of a very different style, but fundamentally of the same *genre*, for though on the dust-sheet it is called an autobiography, it is really an account, not of the author's life (for he is the very opposite of a Pepys or a Boswell), but of his job—the most unusual job, secured through the personal column of *The Times*, of "adviser" to the Sheikh of Bahrain; which meant in effect being Prime Minister and Minister of almost everything else, and managing the affairs of the islands for nearly a third of a century in a patriarchal spirit very similar to that in which the Rajahs managed the affairs of their kingdom. In some ways it was a more complicated task, since he had to deal with a less primitive people who seem incapable of simple-minded loyalty and of whom he can write that "gratitude is an uncommon trait among them—they are by nature unsentimental, cynical and materialistic" and that "every Arab is at heart an opportunist"; but as his story unfolds into what is practically the whole modern history of Bahrain it is surprising how closely it follows the Sarawak pattern: an undeveloped country inhabited by mutually antagonistic races (in this case Shia Baharna and Sunni Arabs from the mainland) is brought into the modern world in the face of corruption, intrigues and attempted revolts, a simple but effective administrative machine is created, the discovery of oil is turned to good account and relations with the British authorities are stabilized after much vacillation and change of policy by the latter or their local representatives. Sir Charles Belgrave, one feels, would have made a very good Rajah. The end of the story, too, is much the same. The Rajahs disappear, the "adviser" leaves and is not replaced; and in both cases the British Government seems almost indecently eager to see them off. For once in a way, the map in this book is quite adequate.

L. COLLIER

FOUNDER OF A CITY. The life of Colonel William Light. By GEOFFREY DUTTON. *London: Chapman and Hall*, 1960. 8½ × 5½ *inches; 323 pages; endpaper maps and plates.* 35*s*

Colonel William Light is remembered by Australians as the founder of Adelaide, and by most Englishmen not at all—which is a pity, for, as this book shows, he was one of the most remarkable characters of the Romantic Age. The illegitimate son of Francis Light, the founder of Penang (and himself the illegitimate son of a Suffolk squire), by a (probably) Portuguese half-caste, a midshipman in Nelson's Navy, a cavalry officer in Wellington's Army, a volunteer fighting for the Spanish Liberals in 1823, a wandering yachtsman and artist in the Mediterranean, commander of a steamer in the service of Mehemet Ali of Egypt, and finally surveyor general in the expedition which founded the colony of South Australia, he was, as will be seen, a versatile hero, described by Napier as "distinguished by the variety of his attainments, an artist, musician, mechanist, seaman and soldier". He had a beautiful wife, the illegitimate

daughter of a Duke of Richmond, who deserted him in Egypt to pursue a career of amorous adventure in the style of Lady Ellenborough. In Australia he suffered even more than most pioneers from the incompetence and malignity of his associates, was driven to resign his surveyorship and died of consumption at the early age of fifty-three, but not before he had seen the city of Adelaide firmly established where he had planned it.

Such a history of adventure, achievement and misfortune, with a Byronic background and more than the usual allowance of illegitimacy, offers a strong temptation to a biographer to give it a highly coloured, "larger than life" treatment; but this temptation Mr. Dutton has, for the most part, creditably resisted. His book is a serious, well documented study, with its emphasis on the last, Australian phase of Light's career, the only one of historical importance. In its earlier part he is inclined to inflate his narrative with references to matters which have little to do with it; and though the Australian chapters are comparatively free from these digressions, they are not easy reading, being largely a detailed account of petty intrigues in the colony, which seems to have been singularly unfortunate in its administrators. This, however, could hardly have been avoided if Light's conduct and proceedings were to be properly understood. What could and should have been avoided is the failure (for which perhaps the publishers were responsible) to provide any general map of the colony, which would show, among other things, the alternative sites for the capital which Light's enemies were constantly suggesting; without this, readers unfamiliar with South Australian geography will be hard put to it to understand the points at issue. On the other hand, there are interesting contemporary portraits and a number of Light's own drawings.

L. COLLIER

SIR WALTER RALEIGH. By WILLARD M. WALLACE. *Princeton: University Press; Oxford: University Press*, 1960. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* ix + 334 *pages; maps and plates.* 35*s*

THE DEFEAT OF JOHN HAWKINS. By RAYNER UNWIN. *London: George Allen and Unwin*, 1960. $8\frac{3}{4} \times 5\frac{3}{4}$ *inches;* 319 *pages; maps and plates.* 25*s*

The West Country could justifiably claim to have served Elizabeth Tudor well throughout her arduous reign. Not only did it act as the main nursery for seamen to man the ships of the Navy and Merchant Venturers, it was also a reliable bastion against any invader attempting to move up channel. Two of its sons who were to play a prominent role in events both at home and abroad were Raleigh and Hawkins. Although both were from West Country stock, they had little else in common. The enigmatic Raleigh was ever seeking the limelight, often with a show of misplaced bravado, while the reticent Hawkins was mostly content to remain in the background allowing his deeds and achievements to speak for themselves. Raleigh was undoubtedly gifted and there are many interesting facets to his character. As Professor Wallace shows, he had a versatility which found expression in his life when he was able to combine soldiering with poetry, exploration with the fineries of court. With the help of recently published accounts of the Elizabethan parliaments and overseas enterprises, the author is able to introduce new ideas and explanations of aspects of Raleigh's life which have long proved puzzling. The treatment throughout is sympathetic to Raleigh, but at times it almost becomes too apologetic in accounting for the whims and acknowledged weaknesses of this fascinating individualist. It is hard to believe that in his differences with the Queen, Cecil, Howard and Essex, Raleigh was consistently in the right and they were so foolish as not to recognize his greatness.

In contrast to the ambition, arrogance, conceit and lofty manner of Raleigh, Hawkins was shy and retiring, qualities which have led to some of his great achievements being overlooked. Rayner Unwin, a writer new to maritime history, has tried to make amends by choosing one brief episode in his crowded life, the third slaving voyage which was to end so disastrously in the harbour of San Juan in Mexico. The expedition set out from Plymouth in 1567 and made for the Guinea coast where they were to pick up the slaves to be traded in the Spanish colonies of the Caribbean. Although engaged in this traffic, Hawkins was certainly not its initiator as has often been suggested.

Rayner Unwin's account makes it quite clear that the young English commander was merely following in the footsteps of the Portuguese and French, who had long been engaged on the lucrative transfer of negroes from Africa to America. The narrative by itself makes interesting reading, and the author has been able, in addition, to use certain events to portray the character of the young Hawkins. Barely a month had elapsed after leaving Plymouth when Hawkins had to face insubordination from Edward Dudley, the commander of the troops on board his ship. To a lesser man of his age and relative inexperience, the situation might have proved disastrous but to Hawkins it was an opportunity to unite the whole company for the arduous task ahead. After Dudley had been tried and found guilty Hawkins, with a carefully planned intervention, administered an act of clemency which was to earn him the respect and loyalty of the condemned man and the whole of the ship's company. Although Hawkins was to be subsequently tricked and trapped by the Spaniards in the harbour of San Juan and he and his crew had to endure great hardships on their return across the Atlantic, there was never any suggestion of mutiny. Hawkins's defeat, bitter though it must have been to him, did unmask the true feelings of Catholic Spain towards Protestant England. He learnt, too, not to underestimate the fighting power of the Spaniards, a lesson which he took very much to heart when given the task of reconstructing and reorganizing the Navy. Twenty years later, as the English ships chased the scattered formations of the so-called invincible Armada, Hawkins, as much as Drake, could claim to be the architect of that famous victory.

A. H. W. ROBINSON

GENERAL

GEOGRAPHY IN AND OUT OF SCHOOL. By E. W. H. BRIAULT and D. W. SHAVE. *London: Harrap*, 1960. 8 × 5 *inches; 199 pages; maps and plates.* 9*s* 6*d*

This is a book for teachers, and not merely for those teachers in country surroundings with plenty of space in which to give a first-hand knowledge of the natural scene, but also for those whose sphere is circumscribed by bricks and mortar. Both for rural and urban areas it bulges with useful and practical advice and suggestions on methods of laying the foundations of a sound understanding of geography. In doing this it distinguishes between the treatment of different grades of intelligence and different aptitudes. One of the strong points of geography as a medium of education is that it has so many various facets as to be able to provide an outlet for almost any aptitude. Among the many practical hints, the description of a walk along a portion of the River Mole is particularly instructive and will be found to be especially helpful to the young teacher. But, in addition to all this assistance to teachers of geography, the book contains much excellent advice on teaching generally, which would apply to any part of the school curriculum.

E. D. LABORDE

GÉOGRAPHIE ET ACTION. By MICHAEL PHLIPPONNEAU. *Paris: Armand Colin*, 1960. 9 × 7¼ *inches; 227 pages.* 19 NF

There is no doubt that those trained in university schools of geography all over the world are turning their attention more and more to the application of their techniques to practical problems. It is interesting that this, one of the first full-length studies of the position, should come from France, where the development has been less marked than elsewhere. Indeed many French geographers have followed their doyen Max Sorre in declaring that "je ne me crois appelé à reconstruire le monde . . . la géographie a quelque chose de mieux à faire". It is not surprising therefore that Professor Phlipponneau, who has proved his sound training by his work on coastal morphology in Brittany, should review at length the present position of applied geography and what its exponents have done elsewhere in the world. He gives a succinct account of what has been accomplished, particularly in the Communist countries and in north-west Europe, notably Britain, and in North America (where he has been visiting professor in the Université de Montréal).

The second and longer part of the book is then devoted to a consideration of the field

of action and the varied problems. He notes applications of geomorphology, climatology, hydrology and biogeography; he devotes a chapter to geography and business —including market research, industrial location and transport, and another chapter to physical planning (l'aménagement de l'espace). It is interesting how many basic concepts of applied geography in English are difficult to express in French: there are no simple equivalents of "survey", "plan", "planning", or even of the word "crowded" as applied to countries or regions.

In this interesting and well balanced book it is strange not to find a single map or diagram. If there is one major contribution the geographer can make, it is the cartographical representation of data. L. DUDLEY STAMP

SHORTER NOTICES

In DISCOVERING THE CAMARGUE (*Hutchinson*, 1960, 25*s*) Monica Krippner gives a delightful account of her sojourn in that strange but fascinating part of Provence, an island enclosed to the east and west by the two arms of the Rhone where it forks at Arles, and bounded on the south by the Mediterranean. For several months Miss Krippner lived in the Camargue and describes effectively life on a *mas* where bulls are bred for Provençal bullfights, and the hard but satisfying life of a guardian who spends his days on the back of the famous Camargue white horse, driving the cattle from pasture to pasture through the *étangs* bordered by swaying reeds, and over the sparse vegetation of the Camargue plains. Not only is the Camargue famous for its cattle and horses, it has, in addition, a wild-fowl sanctuary where the red flamingo lives amongst the marshes and where other migratory birds from Europe and Africa make their seasonal home. Miss Krippner also writes of troubadors and Courts of Love, and of the famous Sara, *patronne* of the gypsies, to whom they pay homage at the annual festival of Saintes-Maries-de-la-Mer, a village renowned from early days, for it was at this point that Hannibal probably crossed the Rhone on his march against Rome. *Discovering the Camargue* is well illustrated in black and white, and has an adequate index. A. E. U.

* * *

Readers interested in Arctic Norway will enjoy Russell Sutherland's LAND OF THE BOG-COTTON (*Hodder and Stoughton*, 1960, 16*s*) which describes his experiences while employed by the Norwegian Government as a dentist. His work took him for six months to Bodø and later to the island of Sortland, where he experienced the rigours of an Arctic winter. Later he visited Honningsvaer in the Lofoten Islands and made a trip in one of the line-fishing boats; his account of the world's largest cod-fishing industry is full of interest. During his last year he travelled to Spitsbergen, and came within 600 miles of the North Pole. Mr. Sutherland has an eye for detail and local colour and his descriptions of people, customs, the grandeur of the Northern Lights, the thrill of ski-ing and the fauna and flora are vivid and sensitive. It is a pity, however, that he has not made his profession more apparent, and written as a travelling dentist rather than as an ordinary traveller. The book is well illustrated in black and white, and has three maps. There is no index. A. E. U.

* * *

Frank Huggett's SOUTH OF LISBON (*Gollancz*, 1960, 21*s*) is an intemperate book. The author seems to have been gloomy on arrival in Portugal, gloomier still on leaving it. Little in modern Portugal earns his favour, so that on a reader fully prepared to admit that neither the Portuguese *pensão* nor the Estado Novo are all that propaganda would have us believe, the impact of much of Mr. Huggett's criticism is reduced. When, on occasion, the writer turns to description of landscape his skill is obvious and the result, as in the opening chapter, is memorable. This book is, then, a revolt against the picturesque, admiring travelogue, but a revolt which has swept its author beyond the limits of objective criticism. P. H.

* * *

CARTOGRAPHICAL PROGRESS

ATLAS OF AUSTRALIAN RESOURCES. Department of National Development, Canberra, 1954–60. *London and Sydney: Angus and Robertson.* 30 *maps* 29 × 17 *inches with text* 10·5 × 7·5 *inches. Complete in box with commentaries,* 15 *guineas a set; maps folded in three boxes,* 12 *guineas a set; separate maps,* 10*s* 6*d each; box containers,* 15*s each*

The reviewer finds it difficult to give an adequate report on this monumental work, since the separate maps have been produced at intervals in the last six years. They have been published without any indication as to how they are to be arranged in a convenient atlas. Perhaps the reader is expected to bind the maps in the order which may appeal to him personally. The sheets measure 30 × 24 inches, and usually the base is a map of the continent on a polyconic projection with the scale of one to six million (94·7 miles to the inch). A very useful feature is that a commentary by a specialist accompanies each large map. Each is a quarto publication of from 12 to 24 pages, and it often contains valuable diagrams and special maps which could not conveniently be placed on the large coloured maps.

For convenience, I propose to discuss the thirty large maps in six classes in the order which has been used in the standard text book of Australian geography (*Australia, Methuen,* 1958), now in its seventh edition. It seems logical to consider the *Structure* first, though the fine geological map was actually the last to be issued in Canberra. In this section we find also a map of the physical features and of drainage basins. Then comes the *Climatic* map covering temperature, rainfall and climatic regions. The third section comprises maps dealing with *Crops and stock,* i.e. a soil map, vegetation regions, forests, croplands, stock distribution, land use and agricultural production. The next section contains maps concerned with *Minerals,* water supply and transport. The last section deals with community aspects of the population, such as density, education, health, immigration, Government and manufactures.

The *Geology* map is a fine piece of colour work, with fifty subdivisions clearly indicated with initials. The commentary by C. C. Noakes can be recommended as a clear summary of Australian geology. It is further illustrated by ten maps showing the latest views of palaeogeography with the ancient land-surfaces clearly marked. The map showing physical features gives only three altitude layers (0–200, 200–500 and over 500 metres). The mountains are boldly shaded and stand out very satisfactorily. The reviewer has strongly opposed the term "Great Dividing *Range*" for the isolated plateaus linked to form the Main Divide, but the former name is perpetuated on the map. In the commentary the better term "Eastern Highlands" is used. The range south-east of Tennant Creek is perhaps too much emphasized. The chief sand-ridges (*ergs*) are differentiated.

The *Drainage* map is one of the most striking, since two features thereon are not usually indicated on government maps. The huge area *without* rivers includes most of the three large states, while the numerous non-permanent rivers are so faintly marked in the map that they hardly appear at all. Thus out of the 975,000 square miles of West Australia—as I indicated fifty years ago—only about 50,000 square miles are shown to be attractive sites for close settlement.

The twenty-three temperature maps are displayed in circular zones about the mean annual map, while special maps give the sunshine data (*isohels*) and extra-high temperature areas. The eastern littoral with a good rainfall is also blessed with abundant sunshine, so that it will undoubtedly rival the Riviera and California as a notable tourist region. So much research has been done on Australia's rainfall that there is not much novel in the series of rain maps. Only 32 per cent of the continent has over 20 inches of rain, while 37 per cent has less than 10 inches. Rain variability and thunderstorm maps are also charted. The large map of *Climatic regions* divides the

continent into five areas based essentially on the usual temperature belts. The commentary by B. W. Newman breaks these zones into twenty-eight lesser divisions where rainfall conditions are introduced. The two usual simple curves (for rainfall and temperature) are given for each type area. The *hythergraphs* (now used in the official atlases of Canada and Argentina) give characteristic diagrams which incorporate *both* elements. New types of curves in the commentary illustrate rainfall variability.

Six maps deal with soils, crops and stock. The *Soil* map is that issued by Dr. Prescott in 1944, which is well known to geographers. A key map shows the small actual areas which have been surveyed in much detail. They are numerous near Perth, Adelaide and the Murray Valley; but naturally vast areas in arid and tropical Australia have hardly been touched yet. The valuable map of *Vegetation regions*—due mainly to R. J. Williams—cannot be profitably considered in a few lines. There are four subdivisions of grassland, and eight in the savannahs. Then follow six divisions of shrub communities, seven of woodlands, six of forests and five in the last division including desert and Alpine floras. Many of the areas show diagonal colour strips indicating a mixture of two divisions. As a result the map is rather complex for the geographer's use, though admittedly a major contribution to plant ecology. The map of *Forest resources* emphasizes the fact that saw-milling is confined to the east coast, Victoria and south of Perth. The area of productive forest is given as 2·3 per cent of the total for Australia.

Two large sheets are devoted to agricultural production and crop lands. The former shows at a glance the small area of the continent—just over one per cent.—which is utilized for crops. The second sheet with four maps shows in detail wheat acreage (by dots), wheat yield (by colour), other major crops and minor crops. The commentary on crops, by R. K. Wilson, gives a valuable account of the new developments in rotation, legume nitrogen, superphosphates and mechanization. The stock map is based on average conditions for the three years 1951–3. The very large proportion where native pastures have been improved is clearly shown by over-ruling. As illustrating the change in Government publications the first paragraph of the commentary may be quoted. "As the map shows there is still some basis for the general impression current overseas that Australia is a large country with huge deserts in the centre around which millions of sheep are depastured".

The last map in this section is entitled *Dominant land use*. It synthesizes previous maps showing the types of stock for breeding or meat, and also charts the areas of dairies, sugar, fruit and timber. In the commentary it is stated that expansion of pastoral lands is unlikely, and that in the south the arid limits of cultivation were closely reached during the 1920's. Only in Queensland (and near Esperance) does agriculture seem likely to expand considerably.

The *Mineral* map embodies an immense amount of information about some seventy minerals, each with a special symbol. The reviewer has always thought little of any map which shows dozens of unimportant mines. In this atlas the differences in the importance of the deposits is indicated by the size of the symbols. Many of the chief mining towns are named specially over the base map. Closely related to the previous map is one charting special features of the mineral industry. The association of many sites of a mineral is shown by patches of colour, while the type and extent of smelting is also indicated.

The *Power and fuel* map shows how complete is the network of power lines within say 200 miles of the southern capitals and Brisbane. A detailed map of the Snowy Mountains area is given in the commentary. All generating stations are shown. Coal areas are indicated (rather approximately) by patches of colour, while the difference between bituminous and brown coal is charted. Several areas noted for oil are charted, but only one (Exmouth Gulf) showed a brief promise in 1953. Very prominent on the map are torpedo-like symbols showing the huge import of oil to the refineries at the capital cities.

The maps dealing with *Irrigation and artesian water* do not depart much from charts adequately published elsewhere. The *Transport* maps chart many data not readily

obtained elsewhere. With each of the various ports are given the associated hinterlands and the chief exports therefrom. Also indicated are the number of berths and of passengers carried. The *Roads* map is a valuable addition, as even outback routes are given as faint lines. The new Beadell's Road across the Western Desert is too new to be inserted. All the main aerodromes are indicated, and it is noticeable how many are in use all round the Eastern (Arunta) Desert. There have been no notable changes in the railway map, but a map in the commentary gives all the commercial airlines.

For thirty years the reviewer has been urging that nation-planning is a far more important field of geographic research than exploration, which in earlier days seemed to be the main object. In the new atlas this view is supported by a special chart of *Major developmental projects*. On the large base map coloured lines and symbols show proposed irrigation, mines, forests, whaling, manufactures, new roads, railways, harbours and airports. Variation in the symbols shows estimates of cost and stage of construction. Very numerous place-names are added to the base map, but no comprehensive summary is feasible in this review. New roads in the districts surrounding Wyndham (W.A.), Alice Springs and the Channel Country (S.W. Queensland) are planned.

The nine remaining maps deal with demographic data rather than with the more usual aspects of geographic research. I have named them in earlier paragraphs, and do not propose to describe them in detail in this lengthy review. In conclusion it seems that we may believe that Australia has reached intellectual maturity. The absence of almost all reference to disabilities and the widespread "wishful thinking" of semi-official publications in the past—as shown by the Government approval of books like *Australia unlimited* (by A. J. Brady), and by the actual black-listing of some serious geographic studies—has nowadays given place to the public avowal and charting of the grave disadvantages present in much of the immense area of Australia.

GRIFFITH TAYLOR

PHILIPPINE CARTOGRAPHY (1320–1899). By CARLOS QUIRINO. *Carmelo & Bauermann: Manila*, 1959. 12 × 9 *inches;* vii + 140 *pages;* 36 *illus.* £21

From their geographical position at the junction of the sea routes across the Pacific and between China and South-east Asia, the Philippine Islands have a special significance in the history of discovery, cartography and navigation. A critical catalogue of maps of the archipelago is therefore a useful reference tool. As Mr. Quirino points out, earlier lists (those of Torres Lanzas and P. L. Phillips) were incomplete and confined to "a mere compilation of titles", while the "authoritative monograph" of T. H. Pardo de Tavera (1910) was issued only in a local periodical. The "Chronological list", which occupies nearly half of Mr. Quirino's book and contains about 1200 items, testifies to the range and thoroughness of his search for materials and presents a comprehensive view of the cartography of the group through the period of discovery and under its successive suzerainties. The descriptive and bibliographical notes are helpful, but in a new edition more consistency of detail should be attempted; scales are seldom given, and dimensions are variously stated in inches, or in centimetres, or without specified unit. While the author regularly notes the source of his information about a map, he frequently fails to record the location of MS. maps; and printed maps are not always entered under the date of their earliest state or edition. The list, which includes many rare and little-known maps, is useful enough to deserve a thorough revision to purge it of a number of errors in fact or statement, especially in respect of sixteenth century works. The spelling of personal names particularly needs overhaul; we find such unfamiliar forms as Ramussio, Ludovico Georgio (for Luis Jorge de Barbuda), James Purchas, Haylyn, and even Petrus Kaerius Caelavit (indexed under Caelavit!).

In his introduction to the list the author examines some of the more significant phases of Philippine cartography. While his treatment is discursive and occasionally naïve, he shows himself well acquainted with the literature of his subject and makes judicious (and acknowledged) use of authorities. Until the eighteenth century,

Spanish official mapping of the archipelago seems to have been strikingly meagre. Mr. Quirino gives a long and interesting account of "the best-known map of the Philippines", that of the Jesuit Father Pedro Murillo Velarde published in 1734 (but here again we are nowhere informed of its scale). The intensive cartographic activity of the American period is no less remarkable, from the publication of Father José Algue's atlas in 1900 to the great *Census Atlas of the Philippines* issued in 1941.

A conspicuous omission from Mr. Quirino's bibliography is Lawrence Wroth's monograph *The early cartography of the Pacific* (1944). The illustrations (with one exception) are well chosen, but have not printed well on the paper used, and the coloured frontispiece in the copy seen is out of register.

In printing only 100 copies of his book the author has plainly underestimated the size of the public which it is likely to interest. It may be hoped that after searching revision he will produce a new edition at a price within the reach of less well-endowed scholars and libraries.

R. A. SKELTON

HISTORICAL ATLAS OF THE HOLY LAND. Edited by E. G. Kraeling. *New York: Rand McNally & Co.* 1959. (Distributed in the United Kingdom by Nicholas Vane, Ltd.) 10 × 6½ *inches;* 88 *pages including* 22 *maps.* 25*s*

This atlas, like several produced recently, attempts by means of maps, photographs and a brief text to outline the historical geography of the Holy Land. Many of these atlases have clearly been inspired by recent archaeological finds in the Middle East so that it is appropriate, perhaps, that this one should start with a short account of the finding of the Dead Sea Scrolls. This is followed by twenty-two coloured maps, many of them spread over double pages. The physiographic map of Ancient Palestine, with hill-shading in greens, yellows and browns, is unusual but effective. The other maps give a wide coverage of Biblical history with period maps of Palestine and maps of, for example, the Assyrian, Persian and Roman Empires. The political maps are overprinted on physical base maps on which the main outlines of relief have been printed in grey. Rarely do these relief features show, for they are masked by the brighter colours indicating political units; where they do, they tend to resemble the "hairy caterpillars" used to indicate relief in earlier times. The colours showing political units and the variety of lettering used for names of tribes and places are, however, pleasant, the lettering reaching an extremely high standard of legibility.

In the second half of the atlas there are seven chapters which deal in chronological order with the history of the Holy Land. Each chapter consists essentially of illustrations and comments on these. A great wealth of material—perhaps, indeed, too much—is packed into these pages. In tables of early and bible history the most important dated events in the Middle East, Egypt and the Western World are tabulated. Finally there is an index to the map section but none to places mentioned in the text. Generally this is a well produced book, but an even more drastic selection of material would have enabled the text and illustrations to have been more spaciously arranged, and would have permitted discussion of some of the controversial points mentioned in the text.

V. B. PROUDFOOT

CORRESPONDANCE MERCATORIENNE. Edited by M. VAN DURME. *Antwerp: De Nederlandsche Boekhandel,* 1959. 8½ × 5½ *inches;* 284 *pages*

Gerhard Mercator bears the most widely known name of all the early cartographers for the simple reason that it was attached to the most useful direction-true projection, which he was the first to devise. It is true that it was not until thirty years later that the Englishman, Edward Wright, drew up the tables necessary to the draughtsman who would prepare the 'Mercator' chart. But the attempt to speak of the 'Wright-Mercator Projection' did not succeed for long.

Gerhard was the pupil of the Louvain mathematician Gemma Frisius, and like his master was a globe-maker and instrument-maker, as well as a scholar. The earliest surviving letters in this collection (1540–50) deal with this period of his life. They are addressed to the Bishop of Arras, who was evidently interested in the problems of carto-

graphy and in the uses of the instruments which he had ordered. The whole collection of the great geographer's correspondence includes two hundred and seventeen items, mostly in Latin, all minutely documented. Only about a hundred of the letters are actually extant, the date and contents of the remainder being conjectured by surviving references to them. To appreciate the book fully the reader should have a general knowledge of the life and work of Mercator, which has been provided, for example, by Averdunk and Müller-Reinhard (1914). By bringing together a correspondence which had been widely scattered and difficult to find, the editor has done a real service, and he has added also some twenty items hitherto unpublished.

Already in 1546 Mercator was preoccupied with the defects of the marine chart, and particularly with the distortion introduced by mapping compass-direction without correction for variation. But unfortunately we find nothing new here about the great world-map of 1569. All that its author says, in seeking a 'privilege' for it from the Emperor Maximilian, is that he has given to the meridians, parallels and directions an arrangement and a symmetry, 'in quibus nauticae tabulae hactenus viciosae admodum fuerunt'. The second Mercator riddle, too, gets no solution from these letters. We still do not know who was his 'English friend' from whom came the map of the British Isles which Ortelius published, although the present reviewer's suggestion that it was John Dee is not entirely rejected. The letter which Mercator sent to Dee in 1577 is, of course, reproduced, and although it has been checked with the original (in the British Museum) by Mr. Colin Clair, the version published in *Imago Mundi* XIII is accepted. The differences amount to no more than a letter or two here and there, nowhere altering the sense of the document. Nor was it the purpose of M. van Durme to offer comment upon or elucidation of the correspondence. Each item is preceded by a few words in French on the nature of its contents, and is followed by a bibliographical note on the whereabouts of the original, if it survives, and of any printed and/or manuscript copies.

Many of the letters, of course, deal with family matters, or with religious discussions held between Mercator and his friends. One of the latter is the last to have been preserved, and was addressed to Wolfgang Haller in August 1592. Two years later Arnold Mylius wrote to Ortelius to say that on the second of December their friend had died, seated in his chair: 'Sic paulatim succedimus omnes'. It is sad to be here reminded that this, and the rest of the wonderful collection of letters to Ortelius preserved at the Dutch Church in Austin Friars, was sold to an American collector six years ago.

E. G. R. TAYLOR

A SKETCH-MAP OF LONDON UNDER RICHARD II. By MARJORIE B. HONEYBOURNE. Re-drawn by W. H. Godfrey and W. G. Prosser. *Publication No. 93 of the London Topographical Society, 9 Rivercourt Road, London, W.6.* 1960.

This valuable map draws on a mass of manuscript sources to depict medieval London expanding beyond its Roman walls by acquiring a girdle of incipient suburbs on its western side and of monastic precincts on its eastern side. The Borough of Southwark is included, but Westminster does not appear, in spite of Tout's dictum that "the history of the capital is the history of its suburbs; it is the history of Westminster above all things". A small-scale version of the map appeared in Ruth Bird's *The turbulent London of Richard II* in 1949. Miss Honeybourne then promised a more detailed map accompanied by "notes giving the full documentation of every place named". If published, such notes will increase the historical geographer's already great debt to the author by revealing her technique of reconstructing from a variety of sources the urban geography of medieval London.

In re-drawing the map on a scale of one inch to 325 feet, great prominence has been given to the City boundary by means of a symbol resembling a chain, and to the river-front by marking it with a quadruple line. Lettering has been elaborated in a style more appropriate to an architectural drawing than to a map. Simpler lettering and finer drawing of boundary symbols would have made physical features such as the Walbrook more clearly visible. There would have been space to show the relative width of streets, instead of representing both Broad Street and the narrowest riverside alley by

means of a single line. The approximate ground-plans of buildings could usefully have been inserted, as it is impossible to visualize the extent of the built-over area from property boundaries alone. The sketch-map in the author's valuable paper on 'The Fleet and its neighbourhood in early and medieval times' in the *London Topographical Record* 19 (1947) 13–87, shows that she has collected material for showing both the width of streets and the extent of larger buildings. G. B. G. BULL

THE ORDNANCE SURVEY, 1959–60

The annual report of the Ordnance Survey for 1959–60 (*H.M.S.O.*, 8s) records a striking increase in the demand for its maps, particularly the 1-inch series which rose by 30 per cent on the previous year's figures. In future, all major road improvements and new motorways will be shown on the 1-inch and smaller-scale maps when they are reprinted, without waiting for a fully revised edition. The 1:1250 resurvey is nearing completion, and work has been concentrated on the 1:2500 plans based upon it. This has necessitated a reduction of effort on the 6-inch and 2½-inch series. Here the aim is the completion of the coverage of England and Wales of the provisional series on National Grid lines of the 6-inch map, and the completion of the revision of the 2½-inch map. This programme has also delayed production of the new half-inch series and of special 1-inch tourist maps. Two sheets of the latter, however, 'Wye Valley and the Lower Severn' and 'Loch Lomond and the Trossachs', are promised for the near future, as well as six more sheets in the quarter-inch (fifth series). A special sheet in this series, 'Wales and the Marches', was published during the year.

The work of the Archaeology Division continues to progress, and the demand for period maps is well maintained. A new map, 'Southern Britain in the Iron Age', is in hand. G. R. CRONE

ONTARIO INSTITUTE OF CHARTERED CARTOGRAPHERS

The Ontario Institute of Chartered Cartographers has been founded in Toronto, and has issued a code of professional ethics. This defines a cartographer in broad terms as "one who designs, constructs and compiles charts and maps at any scale; assembles, evaluates, selects, correlates and plots data thereof; creates map originals for printed reproduction, edits and reviews maps for accuracy and quality." For general membership not less than ten years cartographic experience is required. This is thought to be the first association of its kind in the Dominion, and its certificate of membership has been recognized by the Ontario government. The Hon. Secretary is Mr. H. S. Cox, 2526, Bloor St., W., Apt. 8, Toronto 9.

THE SOCIETY'S NEWS

NEW YEAR'S HONOURS LIST

The Rt. Honble. Viscount Head, Member of Council 1958–60, was made a K.C.M.G. in the New Year's Honours; Brigadier A. H. Dowson, Director of Military Survey and a Member of the Council, was made a C.B.E.; Phillip G. Law, Director Antarctic Division, Australian Department of External Affairs, who received the Society's Gold Medal in 1960, was made a C.B.E.; and Mr. C. Powell-Cotton, Provincial Commissioner, Uganda, was made a C.M.G.

SPECIAL MEETINGS AND FILMS 1960

The year 1960 was the occasion for two of the Society's endowed lectures: on May 30 Sir Mortimer Wheeler delivered the Dickson Asia lecture: "An ancient metropolis of the North-west Frontier: recent work at Charsada"; on October 17 Dr. Eric Axelson, University of the Witwatersrand, gave the first of the Eva G. R. Taylor lectures; he spoke on "Henry the Navigator and the sea-route to India" in commemoration of the quincentenary of Prince Henry the Navigator's death. The Society's principal interest, geographical exploration and research, was reflected in several evening and afternoon lectures: Explorations on the Bolivian–Peruvian border (W. H. Melbourne and Peter Garrard, January 11); Land use in the Serra do Mar, Brazil (Peter Haggett, January 18); The Oxford University expedition to British Guiana (A. J. Cain, February 29); Islands of Western Patagonia (M. W. Holdgate, March 21); Art and society in New Guinea (Anthony Forge, April 11); Jebel Marra, Darfur, (Professor J. H. G. Lebon and V. C. Robertson, May 23); Problems and development of the Dry Zone of West Africa (R. Harrison Church, November 21); Across the South American continent (R. M. L. Mason and A. R. Hanbury-Tenison, November 28); Return to Upper Burma (Brig. B. Fergusson, D.S.O., O.B.E., December 12).

In addition, the programme for 1960 included a lecture on February 8 on the Channel Tunnel by H. J. B. Harding which was particularly well attended; on March 28 Dr. Alice Coleman of University of London King's College, described her plans for the new land use survey of England and Wales; on April 25 C. W. Phillips, Archaeology Officer to the Ordnance Survey, spoke on "The Ordnance Survey and archaeology"; on May 2 Sir Olaf Caroe lectured on "Geography and peoples of the Himalayan and Karakoram frontiers", and on March 7 Dr. A. T. A. Learmonth spoke on "Medical geography in India and Pakistan".

A joint meeting was held with the Geographical Association and the Institute of British Geographers on 1 January 1960, when Professor E. G. Bowen spoke on "The British Seas". Other joint meetings were held with the Institute of Navigation (February 19 and April 22), with the Egypt Exploration Society (October 3), with the British School of Archaeology, Iraq (November 7) and with the Anglo-Swiss Society, when the climber Max Eiselin described "The Ascent of Dhaulagiri" (November 14).

Children's lectures broke rather new ground this year: Captain G. S. Ritchie, D.S.C., R.N., spoke on December 28 on "Charting the reefs of the Persian Gulf", and on December 29 Dr. T. F. Gaskell explained the process of "Searching for oil under the sea". An exhibition, arranged by the Hydrographic Department of the Admiralty, showing how the Royal Navy carries out its surveys, was held from 28 December to 20 January 1961. This was of great interest to some 2000 children or more, attending both lectures, as was also an exhibit, prepared by the British Petroleum Co., to illustrate the underwater drilling operations described by Dr. Gaskell. The exhibition was subsequently visited by over 3570 visitors, including parties from fourteen schools.

Among films shown at the Society's House in 1960 were: "Underwater explorations off Sicily and Cyrenaica", in which N. C. Flemming explained the new archaeological discoveries by the Cambridge University Underwater Exploration Group; "North Pole", a U.S.S.R. film of life on the drifting ice-floe stations, North Pole 3 and 4; and "Forgotten Island", the film of the Oxford Expedition to Socotra.

CONFERENCES HELD AT THE SOCIETY'S HOUSE IN 1960

The London International Youth Science Fortnight, organized by World Friends, and in conjunction with the British Association for the Advancement of Science, held their opening ceremony at the Society's House on July 18 in the presence of H.R.H. The Duke of Edinburgh. Two further meetings were held on July 22 and 27.

From July 7 to 14 the Seventh Commonwealth Entomological Conference held its open meetings in the Society's House. A reception was given by Shell International Petroleum Co. Ltd. for delegates to the conference on July 8.

The Institute of Biology held a two-day Symposium on September 29 and 30 on "The biology of space travel". The Chairmen at the four sessions of the symposium were respectively Professor Sir Lindor Brown, Professor Sir Solly Zuckerman, F.R.S., Professor Sir Harrie Massey, F.R.S., and Dr. A. S. Parkes, F.R.S.

Once again the Society and the Commonwealth Institute held a joint conference for sixth-form pupils. The subject of the conference this year was "Nigeria", and the opening address was given by His Excellency Alhaji Abdul Maliki, High Commissioner for Nigeria in the United Kingdom. The President of the Society, Lord Nathan, and the Director of the Commonwealth Institute, Mr. K. G. Bradley, received the High Commissioner. The Chair was taken by Mr. Bradley, and the lectures were by Mr. Edwin Ogbu, Education Attaché, Nigeria House, and Mr. Philip Mason. Films were also shown. The conference, which was held on October 27, was very well attended.

GEOGRAPHY PRIZE FOR TRAINING COLLEGE STUDENTS

On the recommendation of the examiners, the Council have awarded the Training College Prize for 1960 to Miss Christine M. Stunden of Southlands College, London Institute of Education, for her dissertation 'The City of Bath: an urban study'. Each University Institute of Education is asked to submit the best dissertation (special study or individual work) presented as part of the final examination in geography in its group. Essays should not be sent to the Society by individual Training Colleges. The closing date for the receipt of essays by the Society is 31 July 1961.

THE RECORD

CONTRIBUTORS TO THIS ISSUE OF THE *JOURNAL*

C. W. Phillips is Archaeology Officer to the Ordnance Survey. *Dr. A. T. A. Learmonth* is a lecturer in geography at the University of Liverpool. *Professor E. W. Gilbert* is Professor of Geography in the University of Oxford. *Professor J. H. G. Lebon* has been head of the Department of Geography in the University of Khartoum since 1953; *V. C. Robertson* is a Technical Director of Hunting Technical Services Ltd., and his experience of the Jebel Marra area was gained from studies conducted for the Ministries of Irrigation and Agriculture of the Sudan in 1957/8. *Peter Haggett* is a university demonstrator in geography in the University of Cambridge. *Dr. A. H. W. Robinson* is a lecturer in geography at the University of Leicester. *Ing. H. Sommer*, who is Swiss and is now retired, was chief surveyor of the Iranian Oil Exploration and Producing Company. *Dr. E. M. Yates* is a lecturer in geography at King's College, University of London.

UNIVERSITY NEWS

University of Cambridge

Professor Steers spent half the session 1958–9 as visiting professor at the University of California, Berkeley. He is much engaged with rewriting and revising various books. The recent award of the Royal Geographical Society's Victoria Medal to him gave particular pleasure to us all. Mrs. Steers's forthcoming bibliographical and biographical memoir on Ratzel is a fitting outcome of her contribution to our new Part II course on the evolution and significance of geographical thought. Another Cambridge University Press book is well advanced: *Great Britain, regional essays*, edited by Miss

Mitchell, who is also a contributor together with Professor Steers, A. A. L. Caesar, B. H. Farmer, A. T. Grove, C. T. Smith and B. W. Sparks. Mr. Williams has just returned from a year's leave, during which his book, *Coastal changes*, was published. Mr. Smith made a signal contribution to the Royal Geographical Society's Research Series Number 3 on the Norfolk Broads; this was followed in quick succession by R.G.S. Research Series Number 4, *Norwegian cirque glaciers*, edited by W. V. Lewis, in which six of the eight contributors are past or present members of this department. This publication completes the first stage of a glacier research programme in Norway. Many papers have already been published, mostly in the *Journal of Glaciology*, of stage two of this programme which is being carried out on Austerdalsbreen, Sogne. Imperial College, London, are continuing with the seismic work, and an American party also took part in the 1960 programme. An interesting outcome of this work is evidence of the large amount of slipping of the glacier on its sides and bed. Mr. Lewis is on leave of absence this year, and was awarded a Royal Society and Nuffield Foundation Commonwealth Bursary; he will visit Canada and the United States, including Alaska, from March to September. Mr. Jackson, on behalf of the Department of Geodesy and Geophysics, carried out observations for the precise determination of the strength of gravity at places in North, Central and South America in 1958, and in Australia and Malaya in 1959. Dr. Wrigley, whose Bye-Fellowship of Peterhouse has been replaced by a Fellowship, was awarded the Ellen McArthur Prize in Economic History for his work on "Industrial growth and population change", which will soon be published, as a book, by the University Press; this is a major University Prize, the only previous geographer to win it was Professor Darby, who this year became the first geographer to receive the Cambridge Litt.D. The publication of Mr. Sparks's book on geomorphology scarcely deflected him from his continuing studies of glacial and post-glacial deposits. Mr. Grove revisited Nigeria and was awarded the Society's Back Grant; Mrs. Grove has been elected a Fellow of Girton College and, like her husband, has continued with her various publications. Mr. Haggett visited Brazil in 1959, and continues to specialize in South American studies. Mr. Chorley, who joined the staff in 1958, continues his research into statistical geomorphology and into the history of geomorphological ideas, and Mr. Board, who joined us in 1959, is contributing the major part of a book on South Africa: "The Border region", "Natural environment" and "Land use in the Eastern Cape Province". He spent three months in the Union this summer, having been awarded a Sir Henry Strakosch Memorial Trust Grant. The physiographical laboratory, with its much enlarged wave tank, is being "tooled up" and has enabled us to produce some interesting experimental time-lapse ciné films showing, at high speed, longshore drift, spit building, and even artificial rain removing artificial mountains. Plans have been submitted for enlarging the department including this laboratory. This, in part, results from the increase in the number of research students that have to be accommodated—sixteen are in residence at present. Three Cambridge men obtained D.S.I.R. grants for research this year.

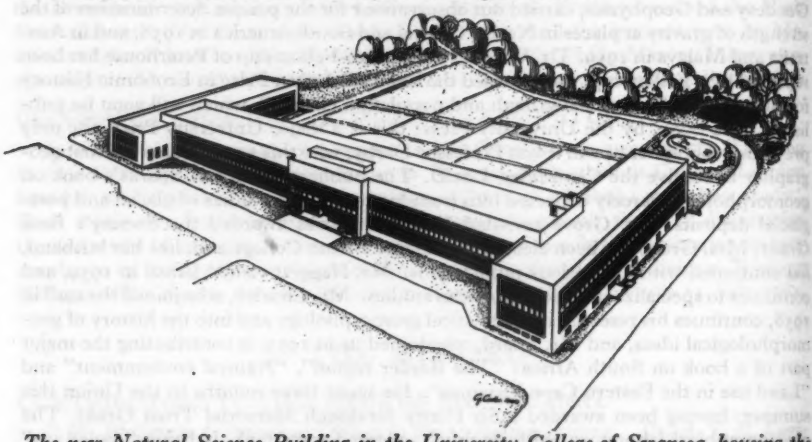
Mr. Caesar is now a Tutor of St. Catharine's College and Mr. Farmer of St. John's College. Dr. Wrigley is Domestic Bursar at Peterhouse. Mr. Caesar and Mr. Farmer produced some interesting statistics of the careers of geographers from St. John's and St. Catharine's Colleges who graduated during the past ten years. Of these, fifty-eight went into business, industry and a variety of related posts, fifty-five are teaching, forty-nine using their geography professionally in universities, for surveying, and in various research establishments; we hope that this points to the wider use of geographers in various posts.

W. V. LEWIS

UNIVERSITY COLLEGE OF SWANSEA

The recent completion of the £800,000 Natural Science Building in the University College of Swansea marks an important step forward in the development of geography in Great Britain. Geography has been studied and taught in the University College of Swansea from its foundation in 1920, initially in the Department of Geology, then from 1931–54 in a joint Department of Geology and Geography, and from 1954 onwards in

a separate Department of Geography with a Chair and full Honours School. In the early 1950's the College Council decided to give priority in building schemes to a new Natural Science Building housing geography, geology, botany and zoology. This building, covering nearly 100,000 square feet of floor space, has been erected in two stages over the last six years; the plan is H-shaped, with two main storeys and a basement, and it is divided almost equally between the four subjects. The accommodation now available to the geography department includes a lecture-laboratory for each of the three undergraduate years; a general lecture theatre seating sixty; staff rooms, research rooms, a departmental office, a drawing office, a set of photographic rooms and store rooms; a large map library and rolled map store. Special laboratories have also been included for advanced undergraduate and post-graduate research work in geomorphology, hydrology, pedology, cartography and photogrammetry. Facilities for the study of meteorology include a work-room and an observation enclosure which has been established in the gardens surrounding the building. A garage has been incorporated for a Land-Rover and Minibus; and the building also houses a joint library and a large joint lecture theatre serving all four departments.



The new Natural Science Building in the University College of Swansea, housing the Departments of Geography, Geology, Botany and Zoology. Architects, Sir Percy Thomas and Son

Interesting features of the equipment in the Department of Geography include power-operated blackout curtains in the lecture-laboratories and extensive use of cork panelled walls for display purposes. Most of the staff and research rooms also have a special fitted service bench unit, which includes hot and cold water points, gas and electrical points, a telephone point, tracing frame and drawer and cupboard facilities. An extensive map library has been planned to accommodate up to 50,000 maps, as the existing collection is already the largest in South Wales, and the Department is increasingly being called upon to provide cartographic data both inside and outside College. The physical laboratory has been equipped with full gas, electrical and water services together with vacuum and compressed air; initial apparatus will include an earth sculpture tank, stream flume and wave trough. The pedological unit is being equipped with standard apparatus for soil and pollen analysis and has rooms for micro-pedology, soil crushing and soil chemistry together with a constant temperature-balance room. A set of four photographic rooms houses a De Vere Horizontal Camera, a Leitz Reprovit 35 mm. copying unit, a Sirius dyeline copier and standard photographic equipment. Photogrammetric apparatus will include a Santoni Stereocartograph III, a Zeiss Stereotope, Zeiss and Bausch and Lomb Multiplex equipment, a Watts Radial Line plotter and Zeiss Slotted Template equipment. Class sets of meteorological

apparatus, survey equipment and binocular stereoscopes with parallax bars have also been provided. Although there is thus a welcome provision of laboratory and library facilities within the Department, care has been taken not to lose sight of the fact that Swansea is situated in the midst of a natural field laboratory. The Gower Peninsula illustrates a wide range of normal and coastal processes of erosion and accretion, whilst the immediate hinterland demonstrates normal and glaciological morphology. South Wales as a whole also exhibits a wide variety of economic and historical landscape changes. Thus, for both undergraduate teaching as well as for the encouragement of research, the Department is enviable in having so close at hand and in support of its new accommodation such a great variety of terrain. The availability of transport enables a balance between field-work, library work and laboratory work to be achieved at all levels.

Courses are offered in both Arts and Science Faculties to Pass and Honours levels; provision is also made for students taking geography as a subsidiary, auxiliary or accessory subject. Honours students are required to select an option in their last year and at present geomorphology, climatology, economic geography, historical geography and cartography are available for detailed study; it is hoped to develop other options in the course of time. The Department is also responsible for the College one year post-graduate diploma in cartography; this course is mainly concerned with the techniques of map and chart compilation and the work involved in the production of topographic maps and charts of medium and small scales.

The members of staff of the Department and their main interests are now as follows: Professor W. G. V. Balchin, M.A. (Cantab.), PH.D. (London), (geomorphology, British Isles); Mr. J. Oliver, B.A. (Bristol), (climatology, S. Asia); Miss G. E. Groom, B.SC. (Birmingham), (geomorphology, Europe); Dr. D. H. Maling, B.A., PH.D., (Dunelm), (cartography, photogrammetry); Dr. S. H. Cousens, M.A., PH.D. (Cantab.), (historical geography, Europe); Mr. G. Manners, M.A. (Cantab.), (economic geography, North America); Mr. H. R. J. Davies, M.A. (Oxon.), (human geography, Africa); Mr. G. Humphrys, B.SC. (Bristol), M.A. (McGill), (industrial geography, North America); Mr. H. J. R. Henderson, B.SC. (Sheffield), M.A. (Liverpool), (agricultural geography, Africa); Miss Glenys Thomas, B.A. (Wales), (Map Curator and Cartographer). The department is fortunate in the very diverse academic background of its staff and the fact that all members have had first-hand experience of the regions upon which they lecture. A departmental secretary and photographic and draughting technicians complete the staff complement.

The creation within so short a space of time of this new Department of Geography, adequately housed and equipped, and now comprising one of the larger Honours Schools within the University College of Swansea, owes much to the solid foundations laid by those who prepared the way in the early years of the College and for the development made possible more recently by the very generous financial aid received from the University Grants Committee. A great cooperative effort has been needed over the last six years to bring the Department into being; there is a measure of success already, however, in a flourishing research group of both staff and post-graduate students who have already produced over fifty published papers, and the fact that the first three Swansea Honours geographers to undertake post-graduate work have this year all been appointed to University lectureships in Australia—Dr. Michael Williams, B.A., PH.D. (Wales) and Mr. T. L. C. Griffin, B.A. (Wales) are going to Adelaide; whilst Mr. B. A. G. Plummer, M.A. (Wales), after a year in the United States and service with the Soil Survey, has taken up a lectureship in Armidale.

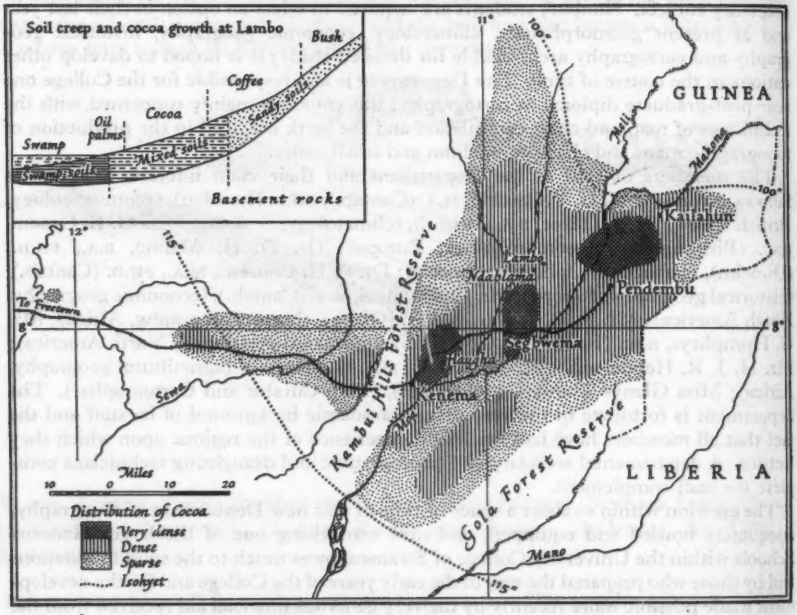
To mark the opening of its new accommodation, and as a contribution to the October 1960 Swansea Festival of Music and the Arts, the department organized, in conjunction with the Ordnance Survey, an exhibition covering "The Mapping of Britain." This exhibition, held in one of the larger assembly halls of the College, was open to the public; many parties were also received from grammar schools, technical schools, training colleges and technical colleges throughout South Wales.

W. V. G. BALCHIN

COCOA IN SOUTH-EASTERN SIERRA LEONE

Since 1922 when Sierra Leone, with a modest 7 tons, began exporting cocoa for the first time, cocoa planting has steadily increased in the south-eastern areas until in 1958 the export figure was 2828 tons.[1] It has gradually become more important in the economy of a country which in many ways is very poor, and although it can never be a serious rival to the larger cocoa-producing areas of Ghana or of Nigeria, it is worth the attention of geographers.

Until recently it was very difficult to map the Sierra Leone cocoa distribution with even reasonable accuracy. Since the whole of the cocoa crop has always been transported by rail to Freetown for export, it had been possible to gain at least some idea of the main cocoa areas, but their extent had always been difficult to ascertain while there were no other data available. During the last decade, however, most of the marketing has been taken out of the hands of the Syrian-Lebanese storekeepers by the growth of



The distribution of cocoa growing in south-eastern Sierra Leone

the government-sponsored Co-operative Societies. Every cocoa area now has a Co-operative Society whose main concern is the marketing of cocoa. Thus a list of the places in which there are such societies will, when plotted on a map, help considerably in defining the densities and boundaries of cocoa distribution. The map above shows the result of combining railway returns, the distribution of Co-operative Societies and field investigation.

It is clear that cocoa growing in south-eastern Sierra Leone requires a much heavier rainfall than it will tolerate in other parts of West Africa, such as the Ibadan-Abeokuta region of Western Nigeria, where it has 45–55 inches per annum.[2] The lower limit in Sierra Leone coincides with the 100-inch isohyet and the upper limit with the 115-inch isohyet; local conditions have, however, enabled cocoa to grow beyond these limits in some areas. But what is most important is the way in which the rain is distributed throughout the year. Under optimum conditions cocoa grows where rainfall distribution is such that a high humidity rate is maintained throughout the whole

year. In Sierra Leone most of the rain falls during the months of July, August and September. An intensive wet season is followed by a dry season, during which harmattan winds are particularly harmful to cocoa. The severity of this dry season increases towards the north and west.[3] In many parts of the country the severity of the dry season has been increased by the destruction of virgin forest and bush fallow, as population pressure has required the reduction of the length of fallow. Forests maintain humidity to a remarkable degree. Heavy mists collected during the night often do not rise until about 10 a.m., or even later in the forested areas, thus reducing the hours of strong sunlight.

In the south-east cocoa can just manage to survive the dry season where the forest cover is sufficient to retain enough moisture. Thus it is confined to those parts where there is still some high forest, or where bush is being allowed to regenerate by being left outside the normal bush-fallow system of agriculture. Where the vegetation gives way to low bush or derived savanna there is not sufficient moisture retention during the driest months, and the planting of cocoa is abruptly terminated. It is this which marks the northern and north-western limits of the cocoa areas. To the south-west the 115-inch isohyet roughly coincides with the edge of the highland zone of Sierra Leone. Between here and the coast is a large area of poor degraded soils and swamps, neither of which is inviting to cocoa growth.

The south-eastern limits of the cocoa areas are set by the Gola Forest Reserve. This is an area of very low population density; it was denuded of inhabitants during the inter-tribal wars of the late nineteenth century, when the Sofas and Golas of Liberia ravaged these parts.[4] Even now the Nomo chiefdom has a population density of only 7 per square mile, and has shown no signs of appreciable increases during recent years. For this reason the forests had been little cleared before government action was taken to ensure that its sylvan nature was retained. Together with the Kambui Hills it forms the largest area of high forest in the country, and as such is a potential source of valuable timber trees. These forests are intended to serve as suppliers of wood to the Kenema Forestry Industries plant. Thus cocoa planting has been prohibited, except for occasional small patches around the widely separated villages. Previously published maps intended to show cocoa distribution have considered the Gola Forest to be the densest cocoa area.[5] It had been assumed, perhaps reasonably in view of the lack of data, that because it had the best physical conditions it was therefore the densest area. But cocoa growth is dependent only partly on physical conditions; other factors also play a part, and not least among these factors is the matter of priorities. The government has accepted the view that cocoa planting and the maintenance of virgin forest are incompatible.[6] This is mainly because to invite increased cocoa cultivation would require the immigration of native labour into the area, for at certain times of the year much manual labour is needed. It has to be appreciated that cocoa growing forms only a part of the economy of the African villager. Virgin forest is particularly valued because its destruction reveals relatively rich agricultural soils, at least for a time. Hence the government's decision to prevent any economic activity which would result in large increases in population.

Cocoa is limited to areas where the high forest coverage has been largely destroyed. What remains is limited to isolated stands of tall trees, usually surrounded by low bush or land in agricultural use. The loss, however, is balanced by the increased transport facilities and higher population densities. The densest cocoa areas are those where transport facilities are at their greatest and also where population is most dense. The Segbwema area is served by the railway and a good road system. The town itself has a population of more than 2500 (town populations are taken from 1952 estimates) and the Jaluahun chiefdom in which it is situated has a population density of more than 130 per square mile (chiefdom population densities have been calculated from 1958 population estimates). The Kenema-Hangha area is also served by a rapidly growing road system, with Kenema, the provincial capital, as the nodal centre. Both Kenema (population more than 4000) and Hangha have rail communications with Freetown. The Nongowa chiefdom, in which both towns are situated, has a population density

of about 235 per square mile. The other area with a very dense cocoa growth consists of most of the Luawa chiefdom (population density about 140 per square mile) in which Kailahun (population about 2800) is an important nodal centre. Although not a railway town the latter has a fairly good laterite road connecting it with Pendembu, the railway terminus.

Transport facilities are obviously important where the whole of a commodity is exported, and it is clear that proximity to towns is important from the point of view of marketing. These alone do not explain the concentrations described above, although they are the most important factors. Also of importance, and less well known, is the social and economic structure of modern Mende society; cocoa production is confined almost entirely to the Mende areas. The economy of the average villager tends to be closer to subsistence than to a fully developed money economy, though he does need money to pay his taxes, for the purchase of clothing, for "pan" roofing material and, if he is literate, for books and writing materials, as well as other things which can make life more pleasant than a pure subsistence economy could ever do. Thus, in addition to subsistence farming, he will grow cocoa, coffee or other cash crops to obtain money. His main concern, however, remains the growing of rice, cassava, yams and other staple foods, and the time and energy expended on these takes first place. The townsman, on the other hand, often has paid employment. He has learnt the value of money and appreciates that he can buy all the food he requires. Among other advantages he can have a more varied diet and much more leisure than the villager. Now by custom he inherits certain areas of bush around his birthplace, and he does not forfeit his rights by leaving the area to reside in a town. If he is a long distance from his birthplace he normally allows relatives to use them, but if he is within a few miles he will tend, other things being equal, to turn them over to cocoa; the renting of land in villages is rare. Thus many villages near to towns have cocoa farms around them owned by people living elsewhere.

Within the bounds of the broad distributional pattern there are great variations in cocoa density over small areas. This is partly related to the social and economic culture of the people, but also to the rather rigid physical requirements of cocoa growth in a distinctly marginal area. Mention has already been made of climatic needs. The need for plenty of shade has also been stressed. In addition, cocoa trees require soils which consist of heavy loams or light clays which are fairly deep,[7] and although they like these soils to be well watered, they will not thrive in swamps. Such requirements are not geographically uniform over wide areas. There are few patches of really suitable soils, most of the soils in the region consisting of very light sands of granitic or schistose origin. In a few cases the washing of sandy soils into swamp soils has produced, where the latter is mainly organic in origin, a very rich soil suitable for cocoa. This has occurred at Lambo, in the Bunumbu area (see inset to map, p. 136). Here the cocoa is growing under high bush on the lower part of the hillside, while coffee, which grows reasonably well on poorer soils, has been planted on the upper slopes, in the light soils. The favourite sites for cocoa farms are old village sites or the surrounds of present-day villages. Most villages, whether old or new, have been built on well-wooded hilltop or upper hillside sites. In earlier times the forest cover provided screens which often hid them from the eyes of their enemies. Furthermore, at least part of this forest cover had a religious significance. Frequently a silk cotton tree was an object of veneration, while the surrounding bush was regarded as sacred.[8] Thus all old village sites and many new ones have an area of high forest around them, in which silk cotton trees figure prominently. Thus adequate shade is provided, as well as soils which have never been exhausted. These soils have in fact been very much improved by the haphazard sanitary arrangements of the Mende people. The margins of these areas of improved soils are characterized by the sudden changes from cocoa trees to coffee bushes. In some villages the cocoa has replaced an earlier tree crop. At Ndablama, for instance, encouragement was given to the large-scale planting of kola after the end of the inter-tribal wars during the final decade of the nineteenth century. When cocoa began to bring greater monetary reward after the end of the Second World War the older kola

trees were replaced by the former. During the last decade the process was completed, and kola has now completely disappeared as a commercial crop.

It is doubtful if cocoa growing in Sierra Leone can go on increasing its acreage to any great extent, although it is usually preferred to coffee, for high-grade cocoa yields a much higher income than coffee. The areas in which cocoa has been planted are sharply defined, not because cocoa will not grow beyond the present margins, but because outside the patches of richer soils it soon deteriorates in quality and is much more liable to disease. Except for one outbreak in 1958 near to Segbwema, "swollen shoot" disease is absent, but black pod is common and takes a heavy toll in marginal areas. Thus coffee, which is almost disease free and requires neither very rich soils nor so much shade as cocoa, is preferred on all but the best soils. The main problem in cocoa production nowadays is not so much the increase in quantity, but to improve the quality, which varies considerably from one district to another. Much advice is being given by District Agricultural Officers and Co-operative organizers, but their work is inevitably hampered by lack of education on the part of the villagers, and by the fact that so many men are absent from their homes for long periods. While some have gone to towns to earn a living, many others have become prospectors for alluvial diamonds. These men put in an appearance at harvest time, and when brushing is necessary, but for most of the time it is the old men, the women and the children who are left behind to cope inadequately with the farming. Nevertheless, cocoa has gained an important if unspectacular place in the economy of south-eastern Sierra Leone which it is likely to maintain in the future.

GERALD T. RIMMINGTON

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[4] Alldridge, T. J., "The Sherbro and its hinterland," 1901, pp. 175, 280.
[5] See, for instance, H. R. Jarrett, 'A geography of Sierra Leone and Gambia,' 1954, p. 61.
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[7] Harrison Church, R. J., 'West Africa,' 1957, p. 109.
[8] Harris, W. T., 'Ceremonies and stories connected with trees, rivers and hills in the Protectorate of Sierra Leone,' Sierra Leone Studies, June 1954, p. 91.

THE CLEAN RIVERS (ESTUARIES AND TIDAL WATERS) ACT, 1960

This short Act, which recently reached the Statute Book, extends to tidal waters the powers of river boards to deal with pollution from new outlets and new discharges of trade or sewage effluents. Except for the Thames, where the Port of London Authority already has powers, it covers all tidal rivers in England and Wales. The Act is of some interest to geographers, firstly because of the problem it posed of defining the seaward limit of rivers or estuaries, and secondly for the use, for the first time in legislation, of the Ordnance Survey's National Reference System.

The 1:625,000 O.S. Physical Map gives the names of all rivers over 20 km. in length and these were considered for the first draft list. Only three of these had to be excluded as non-tidal, while twelve other rivers and estuaries required to be added. These included such cases as the Kingsbridge and Helford River estuaries, harbours like Chichester and such channels as the Solent and Menai Strait.

As the powers of control were not to be extended to cover the open sea or the whole coast, it was necessary to define the seaward limit of some ninety-five "Controlled Waters" or estuaries by drawing imaginary lines across each estuary or group of estuaries. Most of the lines refer to one river, but some, such as that across the Severn, include the estuaries of several rivers. In the case of rivers flowing into the sea more or less at right angles to a fairly straight coast-line, the seaward limit is taken as a line which conforms as nearly as possible to a continuous straight line with the coast. Indeed, in some thirteen cases of narrow-mouthed rivers, such as the Ore, Otter and Thaw, it was deemed unnecessary to define the mouth by a line. Where a river enters the sea by a wide mouth, the ends of the line are drawn as nearly as possible between

the points where the estuary interrupts the general line of the coast, where the shore ceases to be of true sea coast type and becomes estuarine. In practice the points selected are often a little distance on either side of the ideal points, because of the desirability of selecting durable and clearly identifiable landmarks, such as a lighthouse, or the end of a pier or rocky headland.

But in more than half the cases such features in suitable positions either do not exist or are unnamed, or the feature is so shaped that there may be doubt as to the exact point which is intended. In all such cases the points have been identified by means of coordinates of the National Grid, using the full grid reference of two letters and eight figures which will permit of the identification of a point to within 10 metres whenever, as is normally the case, a gridded map of sufficiently large scale is available.

As the Act is not subject to modification in any way short of new legislation, care was taken not to use grid references for features such as Spurn Head or Blakeney Point which are liable to change in shape and position. E. C. WILLATTS

"THE USE OF RADIOACTIVE ISOTOPES FOR THE STUDY OF LITTORAL DRIFT"

"The use of radioactive isotopes for the study of littoral drift" is the title of a paper by J. J. Arlman, J. N. Svasek and B. Verkerk, which appears in the Dutch publication *Philips Technical Review* for 21 June 1960. Radioactive isotopes were first used to trace the movements of sediments under water in the Thames investigation of 1954 and 1955 into problems of silting in the estuary. Since that time, tracers have been used in fluvial and coastal experiments in many parts of the world. Sand and shingle, as well as silt, have been labelled with radioactive tracers and the movement of all these materials under the influence of waves and currents has been widely studied with the aid of this new technique. Much of the pioneer work has been carried out in this country; articles on such coastal experiments have appeared in the *Journal* from time to time.[1]

It is not surprising that the Dutch, with their peculiar coastal problems and their breath-taking plans for land reclamation, should take advantage of the new method. This paper in *Philips Technical Review* is important, not only for showing the value of isotopes in the basic investigations related to the "Delta project," but also as a lucid exposition of the immense possibilities of the method, as well as some of its difficulties and disadvantages. To those unacquainted with the uses of tracers in this field it is a valuable summary of the technique. C. KIDSON

EUROPEAN PLACE-NAMES IN TANGANYIKA

An interesting article on place-names of European origin in Tanganyika appears in *Tanganyika Notes and Records*, No. 54, March 1960. As the author, G. N. Shann, writes, "Many names of foreign origin are likely to be superseded in the near future by local names and will be forgotten." Tanganyika has fewer European names than the neighbouring territories of Kenya, Northern Rhodesia, Nyasaland, Uganda, the Congo and Portuguese East Africa; many of them are, of course, of German origin, and the only Post Office with an English name is John's Corner, called after a local African hotel keeper. Mr. Shann lists 131 names in the five regions into which he divides his territory. The sites of old mission stations are easily identifiable: Wangemannshöhe, for instance, was called after the Berlin Mission Director (1865–94) Wangemann, and Madalena is the Swahili rendering of a White Fathers' Mission dedicated to St. Mary Magdalene. Origins of names vary widely, from the heroic and historical (Livingstone Mountains, Wissmann Bay, Bismarckburg, Stuhlmann Sound), through the romantic

[1] Steers, J. A., and D. B. Smith, "Detection of movement of pebbles on the sea floor by radioactive methods," *Geogr. J.*, **122**, 3 (1956) pp. 343–5. Kidson, C., A. P. Carr and D. B. Smith, "Further experiments using radioactive methods to detect the movement of shingle over the sea bed and alongshore," *Geogr. J.*, **124**, 2 (1958) pp. 210–18; Kidson, C., and A. P. Carr, "The movement of shingle over the sea bed close inshore," *Geogr. J.*, **125**, 3–4 (1959) pp. 380–9.

(Molly's Rock, whence a deserted maiden is said to have thrown herself into the sea). to the frankly humorous—Lake Kitangiri on the Central Plateau was once called "Kenworthy" because a local District Commissioner thought it resembled the famous Commander, later Lord Strabolgi, alleging that it was "broad and shallow, served no useful purpose, and never dried up." Descriptive names (Pyramids, Lion Rock) are not so common as commemorative ones; there is only one instance in Mr. Shann's list of what may be called a nostalgic name—J. A. Grant's Little Windermere; except, of course, for the inevitable Piccadilly Circus.

Necessarily, many old names with picturesque associations will vanish as Europe withdraws from Africa and Mr. Shann is doing a service in recording such incidentals of history as the fact that Stokes's Camp commemorates "an Irishman with a long and chequered career as missionary, agent, carrier, ivory trader, gun-runner and mercenary," who was visited by Stanley in 1889 and eventually, in 1895, executed for gun-running by the Belgians; that Dutch Corner marks the point where the first Afrikaners to come so far north camped in 1900; and that Amelia Bay on Lake Nyasa was discovered by Dr. Laws of Livingstonia in 1879 and named after his sister-in-law.

Reprints of Mr. Shann's article are available from *Tanganyika Notes and Records*, P.O. Box 511, Dar es Salaam, at about 1*s* each.

GEOGRAPHY AND ORCHIDS

As a readable and accurate, though somewhat condensed, account of the climate of the world and the many factors controlling it, the series of four articles by Mr. Volkert in recent issues of *The Orchid Review* is to be recommended. But, as a treatise on the correlations between "Geography and Orchids," and of how a knowledge of this should lead to better cultivation, the articles leave a considerable amount for the reader to deduce for himself.

The first nine sections—The Tropical Zone, The Equatorial Region, Trade-winds and Ocean currents, Effects of altitude, Rainfall, Relative humidity, Monsoon and Warm Temperate Zone—except for a little unnecessary and irrelevant detail on the effects of climate on the peoples of some places, provide a reasoned and logical survey of the climatic conditions prevailing over the main vegetational types of the world. For the successful cultivation of a family of plants found in almost every country from Greenland to the Falkland Isles, at every altitude from sea level to high Himalayan mountain slopes and in nearly all vegetation types as widely differing as tropical rain forest, blanket bog and sand dune, a knowledge of the climate of their habitats is of the utmost importance. Indeed, it is only now that orchid growers are realizing that not all orchids must be grown in stove conditions to flower successfully. Some of our prettiest recent introductions are grown in cold greenhouses, a fact unthought of fifty years ago. In these articles generalizations are of necessity made but are supported by statistical data, most of which is given by the same author in two earlier articles in *The Orchid Review* for October and November 1958.

Section 10—Vegetation—deals more specifically with the effects of the climate on plants and the ways in which they respond to seasonal fluctuations. The reason why the 43° F isotherm is the natural boundary between evergreen and deciduous trees, and why vegetation above 8000 feet in the tropics is savanna type and not evergreen forest, is discussed from sound, entirely empirical facts, and should encourage the reader to do likewise. It is a pity however that only one orchid is mentioned in section 10 and an even greater pity that the last section (11) entitled "Orchids" should not mention one species or even genus.

The plethora of useful information from the preceding sections could have been synthesized in section 11 into hard facts on how to grow orchids more successfully by study of the geographical features of their native countries. Instead, we have a long account of the introduction of rubber trees into Malaya. In all fairness, however, the conclusion drawn in the last paragraph will be of prime importance to the orchid grower—that some species may thrive and excel their normal capacities when transplanted far from their original localities.

P. FRANCIS HUNT

A BOOK LIST OF BRITISH ARCHAEOLOGY

The Council for British Archaeology has issued a successor to their book list for teachers, published in 1949. Its purpose is to list publications providing a comprehensive introduction to this increasingly popular subject, and it may be obtained from the Council's office at 10, Bolton Gardens, London, S.W.5, price 5*s* 6*d*.

British Archaeology: a book list is arranged in four parts, each divided into sections and short sub-sections. One group covers the period from prehistory until the Industrial Revolution, with emphasis on the social and historical background. Another section contains books listed regionally, containing articles of local interest, and further sections list books for children arranged in period and subject group under regions.

The list is comprehensive, well arranged and should prove useful both to the amateur archaeologist and the serious student, and the children's sections should prove useful to teachers.

M. M. SOUNDY

NOTES

A notice has been received from the SUB-ARCTIC RESEARCH LABORATORY OF MCGILL UNIVERSITY, MONTREAL, offering five graduate research assistantships per annum for post-graduate research. These are tenable at the Laboratory which is situated at Schefferville (Knob Lake), a mining town of some 6000 inhabitants in central Labrador-Ungava. The positions carry a stipend of $3880 under an arrangement with the Department of Transport, Canada, for whom the students act as meteorological observers. Application for further information should be made to P. D. Baird, Director of Northern Field Studies, McGill University, Montreal.

* * *

The issue for March 1960 (Vol. 4, No. 1) of *The Journal of Conflict Resolution* is devoted to the geography of conflict; it is edited by Professor George Kish and Professor David Singer, both of Michigan University, and includes articles on 'Economic conflicts in south Asia' by Rhoads Murphy and 'Problems of partition and segregation in Northern Ireland' by Emrys Jones, grouped under the heading 'Two case studies: macrocosm and microcosm'. In the same issue, Richard Hartshorne writes on 'Political geography in the modern world'.

* * *

PACIFIC VIEWPOINT, of which numbers 1 and 2 of Vol. 1 (March and September 1960) are in the Library, specializes in the study of Asian and Pacific problems, and it is further stated on the cover that "A New Zealand and Pacific view is presented on other topics and regions". It is edited by Professor Keith Buchanan and published by the Department of Geography, Victoria University of Wellington, New Zealand, at £1 ($3) a volume, or 10*s* ($1.50) a number. *Pacific Viewpoint*, which is attractively produced on good paper which reproduces photographs and maps equally well, should prove a useful vehicle for geographers in Asian and Pacific areas. Contributions are welcomed from workers in subjects other than geography.

* * *

A revised second edition of A GUIDE TO HISTORICAL CARTOGRAPHY has been presented to the Library by the Reference Department of the Map Division of the Library of Congress, Washington. The editors are W. W. Ristow and Clara E. LeGear. The period of "historical cartography" is limited to the end of the eighteenth century; the selected list, described as "A bibliographic guide to the more useful reference sources", contains sixty-seven items and there is a classified index. The Guide may be obtained free by libraries and other institutions on request to the Publications Unit, Office of the Secretary, Library of Congress, Washington, D.C.

* * *

OBITUARY

FAWCETT ALLEN, Map Curator, R.G.S., 1933–45

Fawcett Allen, who died on February 2 at the age of eighty-five, had served longer on the Society's staff than any other member with the exception of E. A. Reeves. He joined it at 1 Savile Row in 1893, having been "discovered as a promising boy of seventeen" by Mrs. Mill, wife of Dr. H. R. Mill, at that time the Society's Librarian. Allen was of Northern Ireland extraction, his family having moved to the north of England in his youth. When Dr. Mill resigned as Librarian in 1900, Allen was transferred to the Map Room as chief assistant to Reeves. On the latter's retirement in 1933, he was appointed Map Curator, a formal recognition of the position he had in fact filled for several years. At the same time he became a Fellow on the proposal of Dr. Mill. The Map Room, as it is organized today, owes much to Allen's conscientious and careful work during forty-five years. He played the main part in two major reorganizations, the move from Savile Row to Kensington Gore in 1913, and the extension in 1930. As Curator, he did much to expand the Society's collection of pre-Ordnance Survey county maps of the British Isles. During the Second World War, despite difficulties, he took a full share as a senior member in charge of fire-watchers. His term of service, prolonged on account of the war, was only terminated by a serious illness, from which he made an astonishing recovery. In 1913, he edited for the Cambridge University Press a small *Atlas of commercial geography*, and ten years later assisted Dr. Mill in revising his *Commercial geography*. Allen's later years were saddened by the blindness of his wife, to whom he was devoted. He maintained his interest in the Society to the last, and regularly attended the Christmas Meetings. He is remembered with affection, and not least for his pawky humour, by his colleagues on the staff.

G. R. Crone

BRIGADIER-GENERAL T. N. S. M. HOWARD, C.B., D.S.O.

The death occurred on 29 December 1960 of Brigadier-General Thomas Nairne Scott Moncrieff Howard, who became a Life Fellow of the Society in 1903. Born in India in 1872, Brigadier-General Howard was commissioned in the West Yorkshire Regiment in 1892. He served with the Nandi Expedition in Uganda in 1900, the Lango Expedition in 1901, in Somaliland 1902–4, during the First World War 1914–1918, and in Kurdistan in 1923. He was mentioned in dispatches nine times, received the D.S.O. and bar, and was made a C.B. in 1926. Brigadier-General Howard was, in his youth, a friend of Sir Harry Johnston, who proposed him for election to the R.G.S. and with whom he travelled in Uganda, notably in the Mount Elgon area.

SIR HUGH McPHERSON, K.C.I.E., C.S.I.

The death occurred on 17 December 1960 of Sir Hugh McPherson, who had been a Fellow of the Society since 1932, when he was elected on the proposal of the Maharajah of Burdwan. Born on 3 May 1870, the son of Duncan McPherson of Paisley, he qualified for the Indian Civil Service in 1889 and, after two years' probationary period at Balliol College, Oxford, was posted to Bengal. He served there until, in 1912, he was allotted to the newly created Province of Bihar and Orissa. During his thirty-five years of service, McPherson did much cadastral survey and settlement work and, in 1925, was acting Governor of the Province for a short time; he also found time to travel in India. He retired in 1926 and at the time of his election to this Society was Vice-President of the Royal Scottish Geographical Society.

DR. NORMAN MOSLEY PENZER, LITT.D., F.S.A., F.G.S., F.R.G.S.

Norman Mosley Penzer, who was born on 30 September 1892 and died on 27 November 1960, had been a Life Fellow of the Society since 1919. Penzer's interests were wide, including economics, geology, comparative anthropology, folk-lore, the history of exploration and old silver. A list of the books and articles which he wrote reflect all these preoccupations, and he was a member of the Geological Society, the Royal Asiatic Society and the Hakluyt Society, serving for some years on the Council of the latter. He was chiefly known at the R.G.S. for his interest in Sir Richard Burton. He edited a volume of selected papers by Burton and he founded, with Dr. F. Grenfell Baker, the Richard Burton Memorial Lecture at the Royal Asiatic Society. He was General Editor of the Argonaut Press series in the 1920's and 1930's, contributing himself several volumes, including those on Marco Polo and *Spanish voyages to Vancouver*. He had planned to include in this series a definitive edition of the voyages of Captain James Cook, a task now undertaken by the Hakluyt Society. Latterly, he became immersed in his study of old silver and also wrote a monograph on wine labels. Penzer's gifts of scholarship were never as fully developed as many thought they might have been and it will always be a matter of regret that he did not write the definitive biography of Burton it was so well within his power to do.

DR. HUGH SCOTT, SC.D., F.R.S.

Dr. Hugh Scott, who was Assistant Keeper in the Department of Entomology at the British Museum (Natural History) from 1930 to 1948, and formerly Curator of the Zoological Museum, Cambridge University, died on 1 November 1960. He had travelled very widely, mainly in Ethiopia and South-western Arabia, and also accompanied the Percy Sladen Trust Expedition, 1908–9, to study the fauna of the Seychelle Islands. He was primarily interested in entomology, but also went on a collecting trip to the High Yemen to study the geographical distribution of animals and plants in this little-known area which is of especial interest as a meeting-place of European, Asiatic and Ethiopian regions. His account of the journey was published in 1942 under the title of *In the High Yemen*, which ran to a second edition in 1947. He travelled in Central Abyssinia, 1926–7, Southern Ethiopia (Gughí Highlands) 1948–9 and Northern Ethiopia 1952–3. In addition he made shorter journeys to the West Indies, Basutoland and Kurdistan, described in various articles, some of which appeared in the *Geographical Journal*. He served as an entomologist with the R.A.M.C. in the First World War and in the Second World War was attached to the Admiralty and was part author of the official *Handbook of Western Arabia and the Red Sea*.

He was a Fellow of the R.G.S. from 1935–55 and served on the Council from 1940–6. He was elected F.R.S. in 1941 for his many contributions to entomology, especially the Hymenoptera and Coleoptera. E. HINDLE

MEETINGS: SESSION 1960–61

Meeting of 10 October 1960. Dr. Edward Hindle in the Chair

Film: Winter Quarters. By Ralph Keene

Meeting of 17 October 1960. The President in the Chair

Elections to Fellowship: Frederick G. Albon; Captain W. M. Ansari; Alfred H. Babage; Reginald E. Barry; Colin C. Bowden; Alan J. Brignall; Frank A. Calvert; Lord Casey of Berwick and Westminster; Cheng-Song Chia; Maurice K. Chopin; Rev. Max A. X. Clark; John R. Colson; Miss Joan Coomber; Mrs. C. P. Daws; Margherita Lady Howard de Walden; Col. O. C. S. Dobbie; Rev. Capt. Alex Dodds; John F. Fromant; Miss Jacqueline Gover; Michael W. Griffiths; Ronald P. Grigson; Higley Halliday; Alan Prosser-Harries; Graeme H. T. Hart; Miss Carole E. Hayes;

Sister Mary Henry; Sidney Hodgkinson; Miss Janet B. Hyde; Georghios Karouzis; Miss C. M. E. Kiralfy; Leonard Kneller; Miss C. Macdonald; Brian A. Marden; John M. Matthews; Robert Maun; P. F. Beresford-May; James Murray; E. O. Oti; Herbert L. Mostyn-Owen; Denis Richardson; Miss I. J. A. Ridley; Miss M. L. Roberts; David E. Rodway; P. L. Roy; Rev. W. S. Scott; Timothy P. Slessor; Edward A. Smith; Miss M. P. Studd; Paul H. Temple; Sister Teresa; Miss Beryl Tomlinson; John F. B. Turner; Lord Waterpark; Peter R. E. Willey; David C. Beresford-Williams; John G. Wilson; Miss Florence L. Wimhurst; Keith Winterbottom; E. Wokocha

Elections to Associate Membership: M. C. Gideon; Allan M. Hambridge; R. C. Lawrence; C. J. Matthews; Richard N. C. Mordaunt; Miss Julia Papworth; Peter E. Sanderson; Julian A. A. Smither; Peter F. Stacey; Miss Penelope F. Taylor Edward Wu

Paper: Henry the Navigator and the sea-route to India. By Dr. Eric Axelson

Meeting of 24 October 1960. Professor H. C. Darby in the Chair

Paper: Geography and geographers in the Soviet Union. By R. A. French

Meeting of 31 October 1960. Dr. E. W. H. Briault in the Chair

Film: The Hunters

Meeting of 7 November 1960. Joint meeting with the British School of Archaeology in Iraq. President in the Chair

Elections to Fellowship: Percival L. Duncan; Walter P. Q. Feiner; Leslie M. Hipkins; Mrs. Rachel A. Long; Miss Audrey V. Samuel; Keith C. Slater; Miss Vera E. Wood.

Election to Associate Membership: Miss Judith Crinson

Paper: Discoveries at Ur. By Professor M. E. L. Mallowan, C.B.E.

Meeting of 14 November 1960. Joint meeting with the Anglo-Swiss Society. President in the Chair

Paper: The ascent of Dhaulagiri. By Max Eiselin

Meeting of 21 November 1960. Professor Dudley Stamp in the Chair.

Paper: Problems of development of the Dry Zone of Africa. By R. J. Harrison Church

Meeting of 28 November 1960. The President in the Chair

Elections to Fellowship: S. A. Agboola; Jonathan N. Bryant; I. K. Drake; Douglas J. Dunnett; Cecil S. Froats; Robert E. Gilkes; Stephen Goddard; H. B. Gurung; Michael E. Hopkinson; Lt.-Col. A. J. E. Johnson; Ralph H. Johnson; D. C. Ledger; Ian R. Lilburn; Sydney A. Lowe; Alexander F. Maitland; George A. Metcalfe; Lionel Miller; Mrs. Susan J. Northan; Mrs. E. Painter; Dr. S. I. Siddiqi; F. M. L. Smith; Michael J. Smith; Mrs. P. S. Stebbing

Elections to Associate Membership: Miss E. Beckley; Colin C. Evans; Miss G. C. Fowler; Roy Mottahedeh; John C. Skinner

Election to Corporate Membership: Horizon Pictures (G.B.) Ltd.

Paper: Across the South American Continent. By R. M. L. Mason and A. R. Hanbury-Tenison

Meeting of 5 December 1960. Dr. T. E. Armstrong in the Chair

Film: Land of the long day. Introduced by Dr. T. E. Armstrong

Meeting of 12 December 1960. General Sir James Marshall-Cornwall in the Chair

Elections to Fellowship: Dr. Phillip Bacon; James P. Bradford; G. S. Coxhead, B.SC.; Anthony M. Daffern; William H. Delafield, B.A.; David J. Dixey, B.SC.; Major F. C. Eyre; Norman Fox; George F. E. Heslop; William E. Ingram; Edgar B. Jackson; Clifford Kearns, B.A.; Anthony J. Kelly; Stanley Kerry; Donald K. Kimber; Rev. William S. MacBirnie; Gerald McGrath, M.A.; William McL. Mackay; Henry A.

Mayor; William R. Midwinter; Thomas Moorhouse; Rafi Y. Mottahedeh; Gareth Thomas; Donald J. Walker; Alan Wellock; Robert R. Wells

Elections to Associate Membership: Miss V. A. Beal; D. A. S. Copland; R. F. de Robeck; V. Harmsworth; Miss J. M. Kilkenny; Miss R. Ladd; Miss Linda G. Lewis; Miss Ailsa M. Ryan; Timothy M. Venner

Paper: A return to Upper Burma. By Brigadier Bernard Fergusson, D.S.O., O.B.E.

Meeting of 2 January 1961. Dr. E. Hindle in the Chair

Film: A light in nature. Commemoration of the Royal Society's tercentenary

Meeting of 4 January 1961. Joint meeting with the Geographical Association. Professor Austin Miller in the Chair

Paper: New States of South-east Asia. By Professor C. A. Fisher

Meeting of 9 January 1961. President in the Chair

Elections to Fellowship: Miss Veronica Bull; Miss Hazel Davey; George A. Goulty; Richard B. Neel; Capt. James Niblock; Archibald R. Palmer; Henry R. Peters; M. L. B. Polluk; A. C. W. Ryan; J. W. W. Seago; David Short; Colin C. Stark; Alan E. Sykes; Victor Terren; T. D. Vaughan; Miss G. E. Whiting

Elections to Associate Membership: Gregory J. Ashworth; Miss Sarah Bloomfield; Giles T. Watkins

Paper: Portrait of Antarctica. By Emil Schulthess

Meeting of 16 January 1961. Dr. E. W. H. Briault in the Chair

Paper: A university expedition to British Honduras. By J. E. Thorpe and others

Meeting of 6 February 1961. The President in the Chair

Elections to Fellowship: Miss Jean E. Barnicoat; Nicholas O. Boving; Mrs. Bethune Bryce; T. M. Clutterbuck; Robert G. Conybeare, B.SC.; Miss S. Coulson; Richard J. Cowlan, B.A.; John W. Davies; David G. French; Keith I. Gasson; Miss Heather A. C. Harbord, M.A.; R. E. M. Hughes; Miss M. M. Jeffrey, M.A.; Ormonde de Kay; H. E. the Hon. E. Ayeh Kumi; Arthur H. Limon; Miss Grace Martin; Miss Panda A. Maunder; F. D. Metcalfe, B.A.; C. N. E. Mitchell; Dr. Samuel O. Ogunloye; William H. Poland; John G. Price; Bryce M. Ross; G. D. Cowper-Smith; John P. Thomas; James A. Willis

Elections to Associate Membership: Henry J. B. Brett; B. A. Burke; Maxwell M. Davis; Miss V. M. Haynes; Hugh L. Mason

Paper: Etruria's past. By J. Ward Perkins, C.B.E.

Meeting of 13 February 1961. The Bishop of Norwich in the Chair

Film: Greenland

Meeting of 27 February 1961 The President in the Ceair

Elections to Fellowship: Lieut. D. E. Babcock; Douglas A. Baker; Keith S. O. Beavon; Leonard A. Black; Miss Hilda M. Buckley; Francis W. Carter; Keith M. Clayton; Albert D. Cooper; Leslie Cork; Capt. G. L. D. Duckworth; G. M. Evans; Barnard Farr, B.SC.; William G. Hegarty; George E. Hemmen; Anthony J. Hewitt; Frederick Hill; G. F. Hiller; Dwight A. Horne; Derek G. Jackson; Mrs. C. E. Kealy; Marcus J. Mee; Ronald C. Merrell, M.A.; Mrs. Audrey Mutter; Hugh G. Neish; Roger F. Noble, B.A.; C. Alexender Odell; W. H. E. B. Page; M. N. Parfitt; Michael E. Perry; L. A. Pickering; Miss Mary Phelps; H. J. E. Price; L. Rudd; Major T. E. St. Aubyn; G. Seabrook-Smith; Mrs. P. A. Viles; Alan Wakelam; Gerald Webber; John G. Wylde; David P. Young, M.A.; Miss S. M. Mallalieu.

Elections to Associate Membership: Miss P. A. Bear; J. J. Holt; John Jones; Miss S. A. Kaulback; Gordon B. Kennedy; Antony D. King; John S. R. Pitt; Anthony J. Ptolomey; Alan R. Sturt; C. J. D. Walker.

Paper: A summer expedition to Greeenland. By Sir John Hunt and John Sugden.